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INSTRUCTION MANUAL

FACSIMILE RECORDING SYSTEM

CONSISTING OF

FACSIMILE RECEIVER/CONVERTER MODEL RCV-500
FACSIMILE RECORDER MODEL MR-100

Bolt Associates, Inc.
10 Fitch Street
Norwalk, Connecticut 06855
U.S.A.

TABLE OF CONTENTS

SECTION		PAGE
1		
GENERAL DESCRIPTION		
1-1	Introduction	1-1
1-2	Facsimile Receiver/Converter	1-1
1-3	Facsimile Recorder	1-1
SECTION		
2		
THEORY OF OPERATION		
2-1	Facsimile Recording System	2-1
2-2	Receiver	2-1
2-3	Converter	2-1
2-4	Recorder	2-1
	2-4.1 Mechanical Unit Assembly	2-1
	2-4.2 Synchronous Motor Assembly	2-2
	2-4.3 Amplifier Assembly	2-2
	2-4.4 Control Panel	2-2
SECTION		
3		
OPERATION		
3-1	Introduction	3-1
3-2	System Turn-On	3-1
3-3	Operation	3-1
3-4	System Turn-Off	3-2
3-5	Adjustment	3-2
	3-5.1 Tuning	3-2
	3-5.2 Timing	3-2
SECTION		
4		
INSTALLATION AND MAINTENANCE		
4-1	Introduction	4-1
4-2	Receiver/Converter Installation	4-1
4-3	Recorder Installation	4-1
4-4	Receiver/Converter Maintenance	4-1
4-5	Recorder Maintenance	4-1
	4-5.1 Paper	4-2
	4-5.2 Cleaning	4-2
	4-5.3 Helix Wire Replacement	4-5
	4-5.4 Helix Strip Replacement	4-5
	4-5.5 Loop Electrode Replacement	4-6
SECTION		
5		
PARTS LIST		
SECTION		
6		
SCHEMATIC DIAGRAMS		

APPENDIX
A
RADIO RECEIVER INSTRUCTION BOOK

APPENDIX
B
RECEIVER MODIFICATION

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1-1	Facsimile Receiver/Converter	1-2
1-2	Facsimile Recorder	1-3
4-1	Receiver/Converter Installation Data	4-3
4-2	Recorder Installation Data	4-4
6-1	Facsimile Converter Schematic	6-2
6-2	Facsimile Recorder Schematic	6-3
B-1	Receiver Modification Schematic	B-2

LIST OF TABLES

TABLE	TITLE	PAGE
1-1	Facsimile Converter Technical Characteristics	1-1
1-2	Facsimile Recorder Technical Characteristics	1-4
5-1	Parts List for Facsimile Converter	5-1
5-2	Parts List for Facsimile Recorder	5-2

SECTION I

GENERAL DESCRIPTION

1-1 INTRODUCTION

The Facsimile Recording System provides the equipment necessary to receive radio-transmitted graphic data such as weather maps and sea condition charts. The equipment consists of a receiver/converter and a recorder.

1-2 FACSIMILE RECEIVER/CONVERTER

The facsimile receiver/converter (figure 1-1) accepts an rf signal from the antenna system, converts the signal to af, and conditions the af signal for output to the recorder. For a description of the receiver portion of the receiver/converter, refer to Appendix A modified as shown in Appendix B . The modification transfers speaker on-off switching from the PHONE switch jack to a SPEAKER switch on the converter panel. For technical characteristics of the receiver, refer to Appendix A. For technical characteristics of the converter, refer to table 1-1.

Table 1-1 Facsimile Converter Technical Characteristics

Model RCV-500

OUTPUT:	Conditioned audio signal
	Receiver speaker on-off control
INPUT:	Audio signal from receiver
POWER:	115v 60cps from recorder

1-3 FACSIMILE RECORDER

The facsimile recorder (figure 1-2) accepts a conditioned signal from the receiver/converter and produces copy as commanded by the signal. For technical characteristics of the recorder, refer to table 1-2.

Figure 1-1 Bolt Associates Facsimile Receiver/Converter Model RCV-500

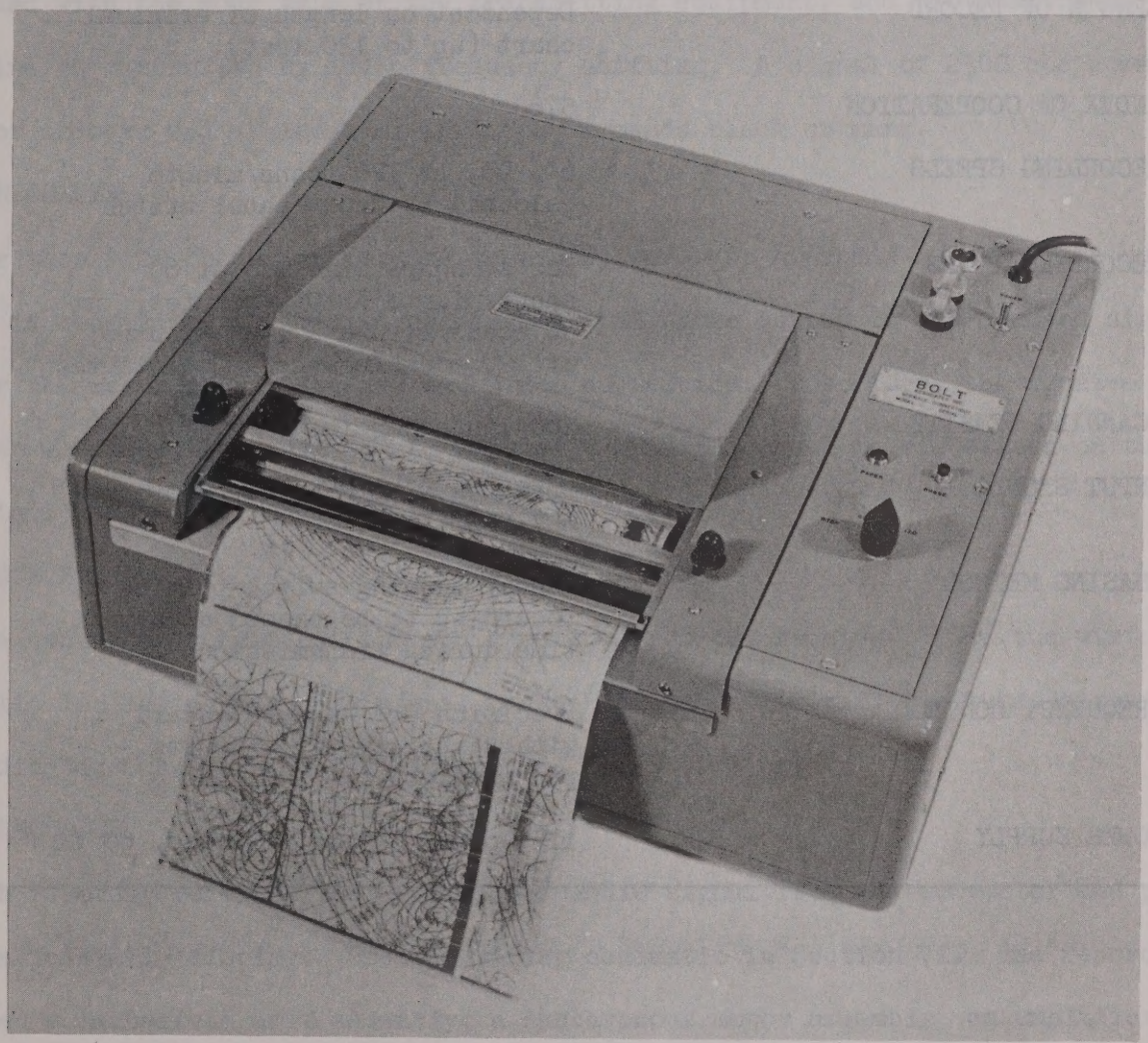

Figure 1-2 Bolt Associates Facsimile Recorder Model MR-100

Table 1-2 Facsimile Recorder Technical Characteristics

Model MR-100

RECORDING MEDIUM	Moist electrosensitive paper on rolls 11" wide x 2-3/4" diameter (120' long)
WIDTH OF RECORD	10-7/8"
LENGTH OF RECORD	Dependent on length of original chart (up to 120 feet)
INDEX OF COOPERATION	576
RECORDING SPEEDS	60, 90, or 120 scans/minute Selected by front panel switch
RECORDING TIMES	For standard size map at 60 scans/minute - 19.2 minutes; at 90 scans/minute - 14.4 minutes; at 120 scans/minute - 9.6 minutes
SCANNING DENSITY	166 lines per inch
INPUT SIGNAL	Operates with Receiver/Converter RCV-500
PHASING METHOD	Manual phasing switch permits recording to be phased at any time during transmission
FREQUENCY CONTROL	Precision frequency standard with stability of ± 3 parts per million
POWER SUPPLY	115 volts, 60 cps, 1-phase, 60 VA

SECTION II

THEORY OF OPERATION

2-1 FACSIMILE RECORDING SYSTEM

The facsimile recording system uses audio frequency shift keying to convert radio transmission to graphic reproduction. The scan rate of the recorder is synchronized with the scan rate of the transmitting equipment, and the marking on the scan line is controlled by audio frequency shifting. A signal of 2300 cps commands white or no mark and a signal of 1500 cps commands black or mark.

2-2 RECEIVER

For theory of operation for the receiver, refer to Appendix A. When the receiver is receiving facsimile transmission, the audio output is the command signal for the recorder and speaker sound has no meaning. Therefore, the receiver has been modified (Appendix B) to provide a SPEAKER manual on-off switch on the converter.

2-3 CONVERTER

The converter conditions the audio output from the receiver. See the wiring schematic in Section VI. The signal passes through a limiter, two tuned circuits, two indicator tubes, and a discriminator.

2-4 RECORDER

The recorder receives the conditioned audio signal from the converter and produces a facsimile display. See the wiring schematic in Section VI. The recorder includes a mechanical unit assembly, a synchronous motor assembly, an amplifier assembly, and a control panel.

2-4.1 Mechanical Unit Assembly. The mechanical unit assembly is the basic facsimile recording mechanism. The scan line is generated by the point of contact between the helix wire and the loop electrode. Moist recording paper, fed between the two electrodes, is marked when current of

the proper intensity and polarity is passed between them. To insure uniformity of the recording line, the helix wire is mounted on a helix strip consisting of many spring-loaded retaining clips. These clips serve to retain the helix wire and assure uniformity of pressure between the electrodes along the length of the scan line. To minimize wear of the loop electrode, it is slowly moved along the scan line by a separate motor-driven mechanism so that wear is distributed evenly along its entire length.

2-4.2 Synchronous Motor Assembly. The synchronous motor assembly consists of a three-speed motor and appropriate gearing to provide scanning rates of 60, 90, and 120 rpm and paper feed rates compatible with an index of cooperation of 576.

2-4.3 Amplifier Assembly. The amplifier assembly provides the precision 60-cycle power (± 3ppm) to drive the motor and the printing power to mark the chart with signals received from the converter. The precision 60-cycle signal is derived from the tuning fork oscillator and amplified to provide 150 volts for driving the motors. The circuit of transistors Q307, Q308, and Q309 is a power amplifier for the facsimile signal and the printing power to the electrodes. All the solid state circuits are powered at +12vdc from a conventional highly-filtered power supply. Relay K301 is normally energized in the recording modes through the paper switches in the Mech Unit. When the paper supply is exhausted, these switches open, de-energizing K301. The relay, in turn de-energizes both precision ac and signal amplifiers by opening a ground connection (Q303, Q304, Q308, Q309) and connecting the PAPER indicator, a flashing red lamp, across 12vdc.

2-4.4 Control Panel. The control panel contains the controls and indicators

for the recorder. The POWER switch closes ship's power to both the recorder and the converter. Phasing is accomplished by the PHASE switch (S302) which normally shorts R308, a 4.7K resistor in the emitter circuit of Q302. When S302 is pressed, the 4.7K resistor is connected into the emitter circuit, drastically reducing the driving power to the sync motor and causing it to slip. Scanning speed change is accomplished by S303, a four-position selector switch. In STBY position, neither motor nor print power circuits are operative. In the other positions, the selected windings of the sync motor are switched across the precision ac power line to produce the desired scan rate of 60, 90, or 120 rpm. The 2A SB fuseholders contain neon indicators which light when a fuse is blown. The PAPER indicator flashes red when the paper supply is exhausted. The recorder will also stop running and printing when this happens.

SECTION III

OPERATION

3-1 INTRODUCTION

This section contains instructions for operation of the facsimile recording system. For receiver detailed information, refer to Appendix A.

3-2 SYSTEM TURN-ON

a. Verify antenna connection to receiver.

b. Turn receiver FUNCTION knob to ON position and verify that dial lights.

c. Turn recorder selector knob to STBY position.

d. Place recorder POWER switch in ON position.

e. Place converter SPEAKER switch in ON position.

3-3 OPERATION

a. Press receiver pushbutton for transmission frequency.

b. Turn BAND SELECTOR knob to position which includes transmission frequency.

c. Turn RF GAIN knob fully clockwise (position 10).

d. Turn TUNING knob to place dial pointer on desired frequency and adjust to peak output noise.

e. Place BFO switcn in ON position.

f. Adjust PITCH-KC knob for desired audio tone, and AF GAIN and RF GAIN knobs for desired audio level.

g. Turn FUNCTION knob to FAX/AGC position.

h. Adjust PITCH-KC knob for converter WHITE and BLACK indicators. Each indicator should overlap at center in response to applicable signal pulse.

i. Place converter SPEAKER switch in off position.

j. Press recorder PHASE pushbutton and verify phase mark moves to righthand side of chart.

k. Turn recorder STBY-60-90-120 knob to position for rate selected by transmitting station.

1. Adjust converter LEVEL knob for recording intensity.

3-4 SYSTEM TURN-OFF

a. Place recorder POWER switch in off position.

b. Turn receiver FUNCTION knob to OFF position.

3-5 ADJUSTMENT

For receiver adjustment instructions, refer to Appendix A.

3-5.1 Tuning. Quality of recording can be used as an indicator for fine tuning the receiver. This procedure is useful when the system is operating under poor receiving conditions.

3-5.2 Timing. The precision timing circuit in the recorder permits scan synchronization with the transmitting station. If the facsimile copy skews, the receiving system and the transmitting station are out of sync. To calibrate receiving system timing, proceed as follows:

a. Install 6700KC or 11,700KC crystal in receiver and tune to WWV.

b. Operate system and record WWV one per second tick at a scan rate of 120 rpm for 10 minutes.

c. Measure skew distance and compute timing error.

EXAMPLE

10 minutes at 120 rpm at 10 inches per sweep is 12,000 inches.

If total skew is 1/8 inch, timing error is 1/8 divided by 12,000 or 10 parts per million.

d. Adjust timing by trimming tuning fork oscillator potentiometer located on motor amplifier chassis. Timing error is not to exceed 5 parts per million.

7-10

SECTION IV

INSTALLATION AND MAINTENANCE

4-1 INTRODUCTION

This section contains instructions for installation and maintenance of the facsimile recording system.

4-2 RECEIVER/CONVERTER INSTALLATION

Attach receiver/converter (figure 4-1) to bulkhead with 5/16 bolts. Locate the receiver/converter within 8 feet of a grounded 115v 60 cps 50w power outlet and within 6 feet of the recorder. Note clearance dimensions shown in figure 4-1.

4-3 RECORDER INSTALLATION

Attach recorder (figure 4-2) to table top with 5/16-18NC bolts. Locate the recorder within 8 feet of a grounded 115v 60 cps 60w outlet and within 6 feet of the receiver/converter. Observe clearance dimensions shown in figure 4-2.

4-4 RECEIVER/CONVERTER MAINTENANCE

For receiver maintenance information, refer to Appendix A. The converter requires only visual inspection and replacement of damaged or malfunctioning parts.

4-5 RECORDER MAINTENANCE

Since each roll of paper provides extended operation (over 60 hours at 60 rpm), paper usage is the basis for periodic maintenance. Perform the following maintenance operations as indicated:

ROLLS OF PAPER	MAINTENANCE PROCEDURE	PARAGRAPH
As req.	Replace paper	4-5.1
1	Clean mech unit	4-5.2
10	Replace helix wire	4-5.3
20	Replace helix strip and loop electrode	4-5.4 4-5.5
As req.	Calibrate timing circuit	Section III

4-5.1 Paper. The recording paper is supplied in sealed polyethylene bags to preserve its moisture content of about 40%. In these bags, the paper may be stored indefinitely, under normal ambient conditions, without deterioration. The mechanical unit is designed with built-in seals to preserve the moisture content of the paper while it is in the recorder. When paper is in the recorder, the cover should be kept tightly locked. If a partially used roll of paper is taken from the recorder, it should be put back in its polyethylene bag and the bag resealed.

Exhaustion of the paper supply will cause the recorder to stop automatically and PAPER alarm on the front panel to flash red. Turn the front panel function switch to STBY before doing anything else. To expose the paper supply compartment, unlock the cover and open it. Remove the excess paper and the paper roll supports from the paper supply compartment and follow the cleaning directions.

To load paper, seat the new roll securely down into the paper supply compartment with the paper feeding off the top of the roll. Pull the paper forward and pass it over the front edge of the recorder. Close the cover and resume operation.

If the recorder has been standing idle for an extended period of time, unlock the cover and pull forward 2 or 3 inches of paper before starting operations, so that fresh moist paper is passed between the electrodes. As soon as the paper leaves the sealed recording compartment, it starts to dry and is normally completely dry by the time it passes over the front edge of the recorder.

4-5.2 Cleaning. To insure the sharp clean recordings, clean the helix wire and loop electrodes, and their supports and surroundings, after every roll of paper is used. A small lint-free brush and some moist record-

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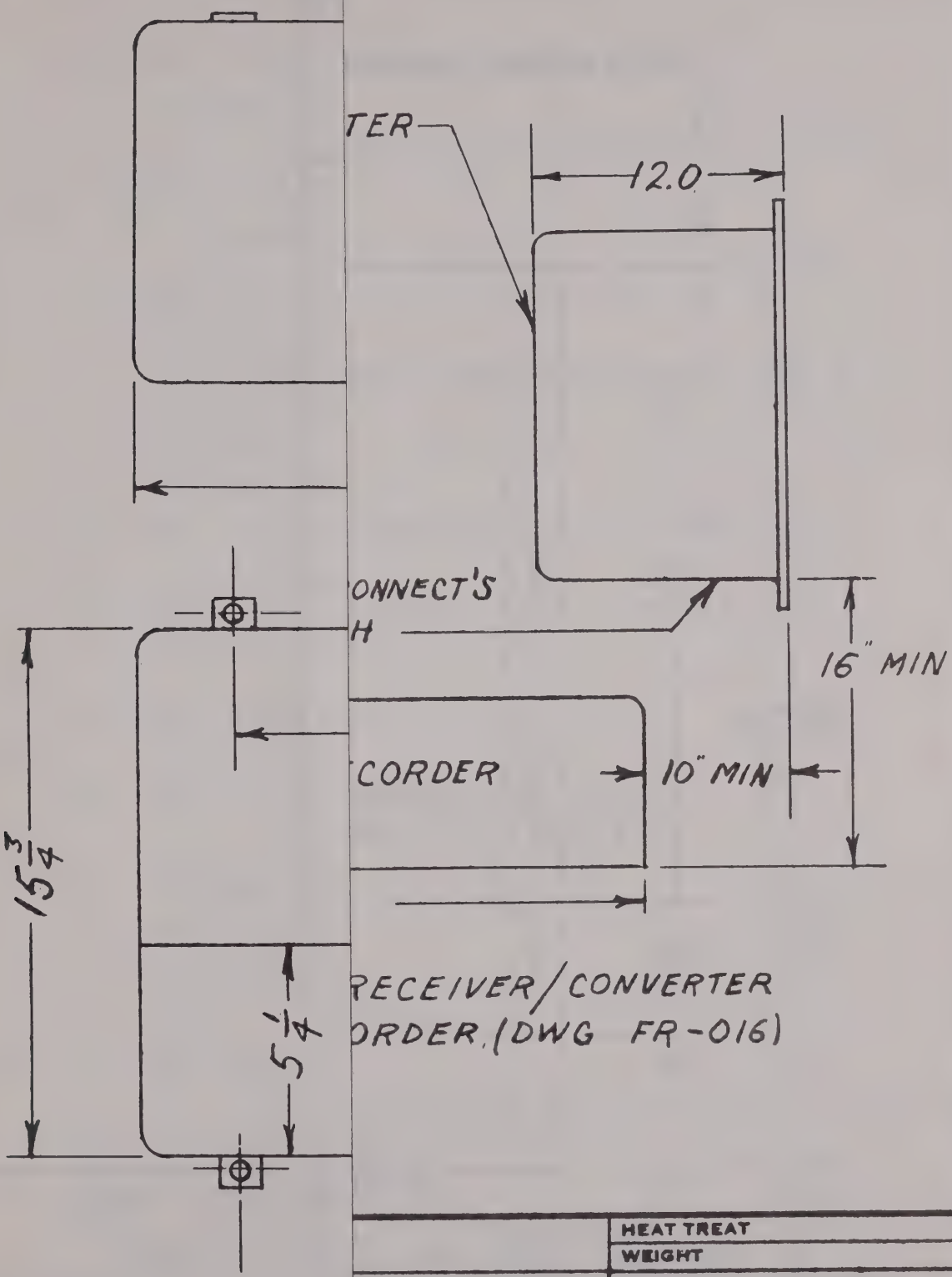

	HEAT TREAT
	WEIGHT
ceiver/Converter ation Data	BOLT ASSOCIATES, INC. 10 FITCH STREET NORWALK, CONN.
DATE 1/25/66	SIZE: — DRAWING NUMBER: FR-017 — ISSUE: —
DATE	
DATE	

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. ULTRAVEL NO. 490

4-5.1 Paper. The recording paper is supplied in sealed polyethylene bags to preserve its moisture content of about 40%. In these bags, the paper may be stored indefinitely, under normal ambient conditions, without deterioration. The mechanical unit is designed with built-in seals to preserve the moisture content of the paper while it is in the recorder. When paper is in the recorder, the cover should be kept tightly locked. If a partially used roll of paper is taken from the recorder, it should be put back in its polyethylene bag and the bag resealed.

Exhaustion of the paper supply will cause the recorder to stop automatically and PAPER alarm on the front panel to flash red. Turn the front panel function switch to STBY before doing anything else. To expose the paper supply compartment, unlock the cover and open it. Remove the excess paper and the paper roll supports from the paper supply compartment and follow the cleaning directions.

To load paper, seat the new roll securely down into the paper supply compartment with the paper feeding off the top of the roll. Pull the paper forward and pass it over the front edge of the recorder. Close the cover and resume operation.

If the recorder has been standing idle for an extended period of time, unlock the cover and pull forward 2 or 3 inches of paper before starting operations, so that fresh moist paper is passed between the electrodes. As soon as the paper leaves the sealed recording compartment, it starts to dry and is normally completely dry by the time it passes over the front edge of the recorder.

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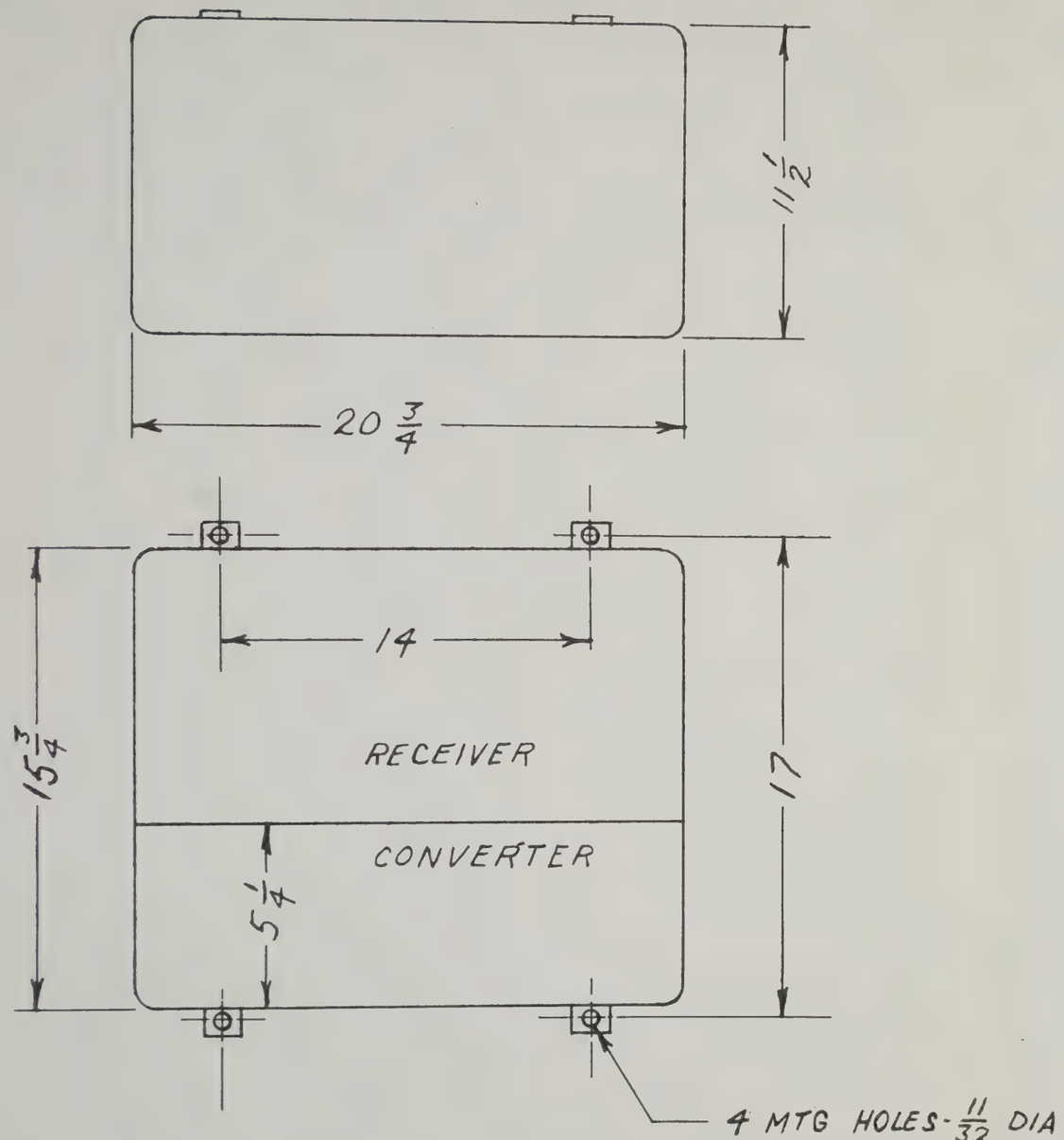
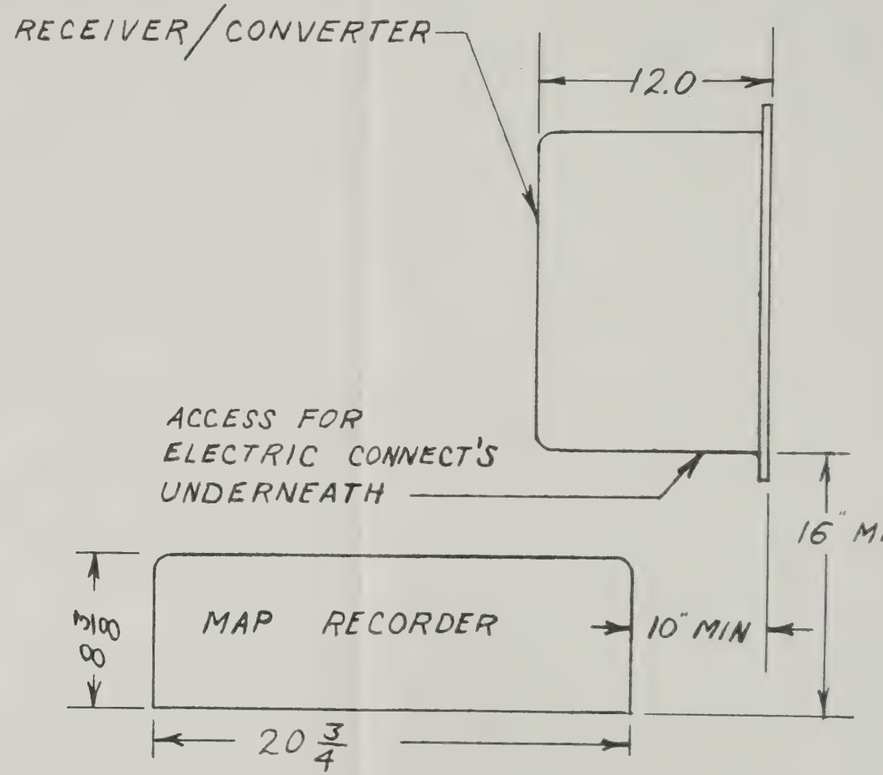
SYM	DESCRIPTION	DATE	APPROVAL



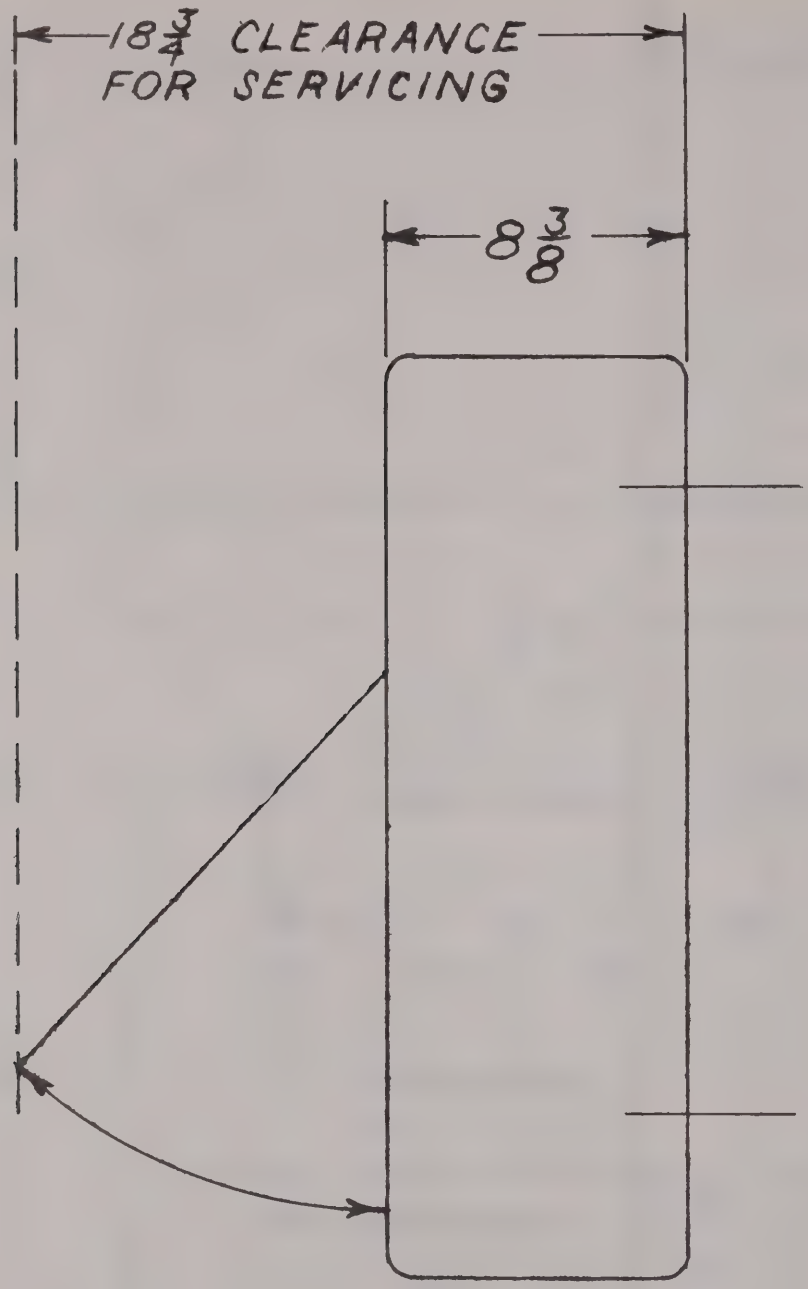


INSTALLATION: RECEIVER/CONVERTER AND MAP RECORDER (DWG FR-016)

MATERIAL	FINISH	HEAT TREAT
		WEIGHT
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED: FRAC. ± 1/64; DEC. ± .005; ANG. ± 30'	TITLE: Figure 4-1 Receiver/Converter Installation Data	BOLT ASSOCIATES, INC. 10 FITCH STREET NORWALK, CONN.
SCALE 3/16 = 1" NO. REQ'D	DRAWN CAO DATE 1/25/66	SIZE: — DRAWING NUMBER: FR-017 ISSUE: —
NEXT ASSY.	CHECKED DATE	
	APPROVED DATE	

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. ULTRAVEL NO. 490M

FR-016



BOLT ASSOCIATES, INC.
EAST NORWALK, CONN.

SCALE: 3/16 = 1"	APPROVED BY	DRAWN BY QJD.
DATE: 8/6/65		

Figure 4-2 Recorder Installation Data

DRAWING NUMBER
FR-016

ing paper are required.

To expose the mechanical unit sub-assemblies:

a. Unlock and open cover.

b. Unscrew target screws which hold down the top plate. These are the first and third screws from the front on each side of the top plate.

c. Lift top plate and lock to cover.

d. Using small lint-free brush and moist recording paper, free all components of mechanical unit from accumulated dust and wipe clean. The helix strip and wire are cleaned with a moist brush or moist piece of recording paper while the drum is rotated slowly by hand in normal direction. Care should be exercised to see that the helix wire is not displaced from the retaining clips. Before securing top plate and cover, check that the helix wire is in place along the entire helix length.

4-5.3 Helix Wire Replacement. To replace the helix wire, expose the drum as in cleaning and proceed as follows:

a. Rotate drum in normal direction by hand until leading end of helix wire is about to disappear under drum.

b. Starting from middle, lift wire out of retaining clips. Work toward leading end.

c. Unhook leading end of helix wire from cam and, rotating drum by hand in normal direction, lift off wire. Work toward trailing end.

d. Unhook trailing end of helix wire and remove.

e. Hook end of replacement helix wire on leading end of helix strip.

f. Rotate drum by hand in normal direction and, while guiding wire, hook wire to trailing end of helix strip.

g. Continue rotation by hand and secure wire in each retaining clip. Check that wire is securely seated in every retaining clip.

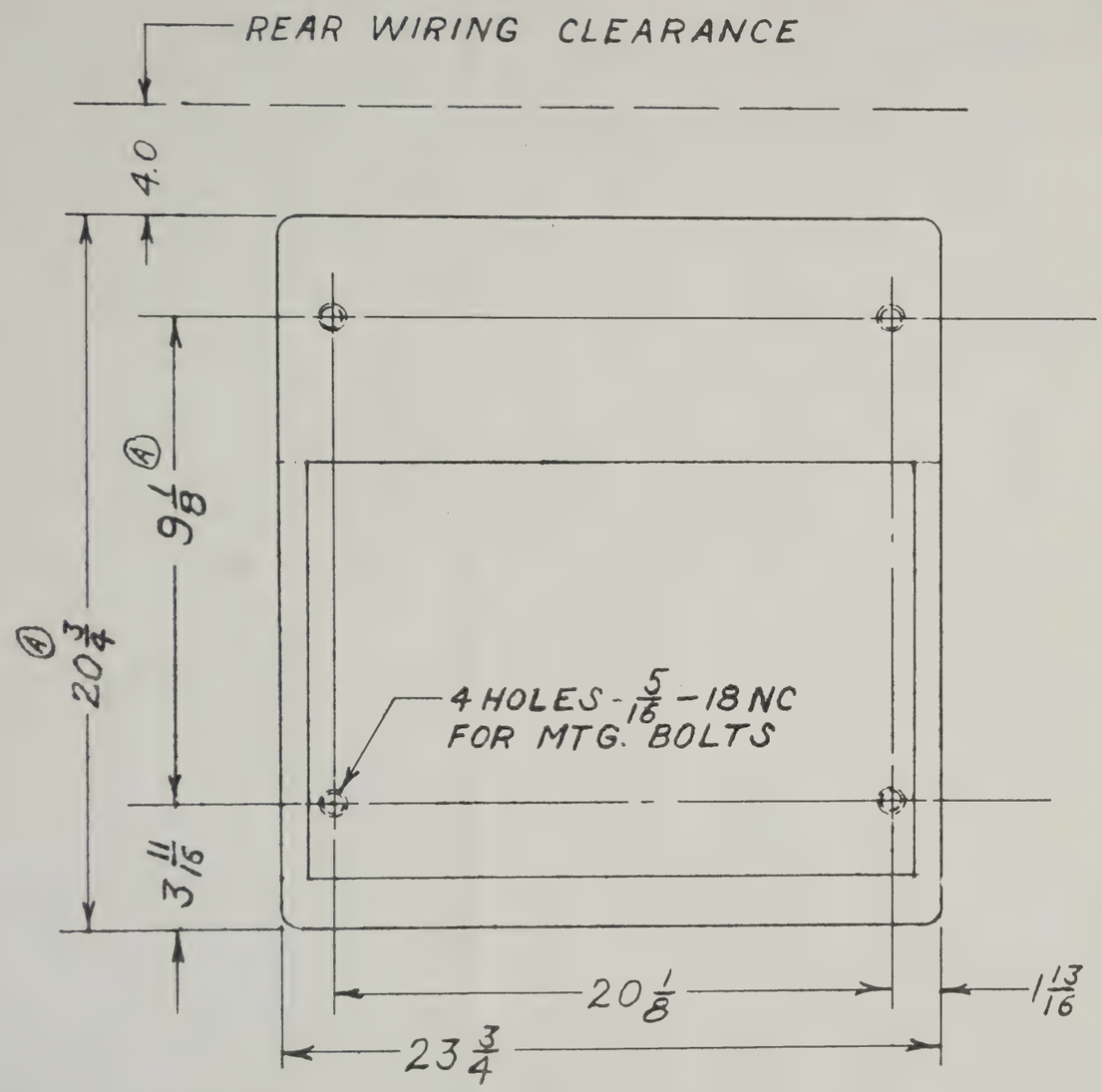
4-5.4 Helix Strip Replacement. To replace the helix strip, expose the drum as in cleaning and proceed as follows:

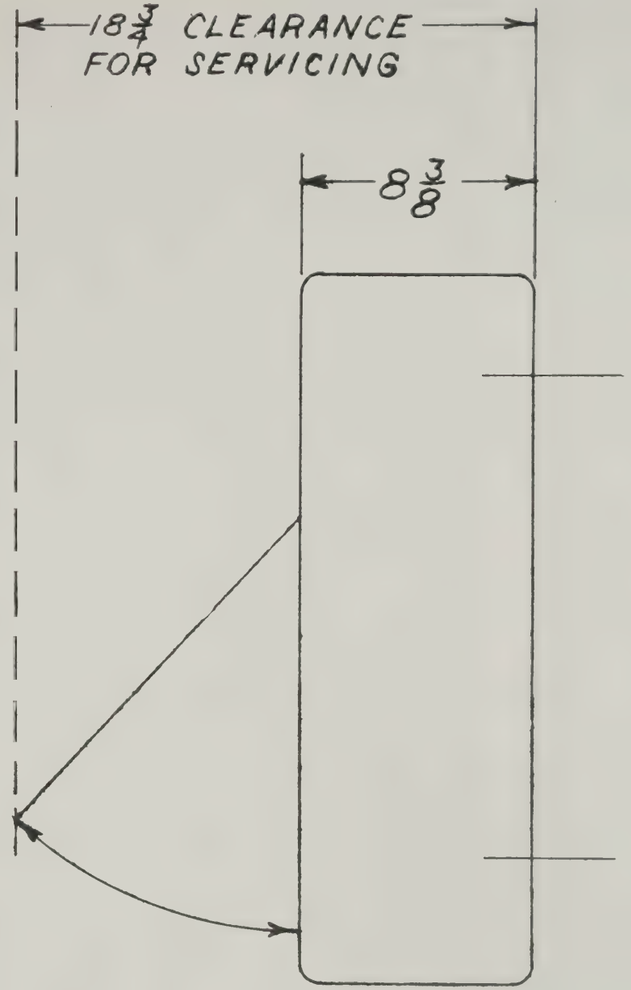
a. Remove helix wire (paragraph 4-5.3).

b. Turn cam at leading end of helix strip 1/2 turn with screw driver and free strip from end of drum.

c. Slowly rotate drum by hand in normal direction and lift strip from

FR-016





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BOLT ASSOCIATES, INC.
EAST NORWALK, CONN.

SCALE: 3/16 = 1"	APPROVED BY	DRAWN BY QAD.
DATE: 8/6/65		

Figure 4-2 Recorder Installation Data

DRAWING NUMBER
FR-016

ing paper are required.

To expose the mechanical unit sub-assemblies:

a. Unlock and open cover.

b. Unscrew target screws which hold down the top plate. These are the first and third screws from the front on each side of the top plate.

c. Lift top plate and lock to cover.

d. Using small lint-free brush and moist recording paper, free all components of mechanical unit from accumulated dust and wipe clean. The helix strip and wire are cleaned with a moist brush or moist piece of recording paper while the drum is rotated slowly by hand in normal direction. Care should be exercised to see that the helix wire is not displaced from the retaining clips. Before securing top plate and cover, check that the helix wire is in place along the entire helix length.

4-5.3 Helix Wire Replacement. To replace the helix wire, expose the drum as in cleaning and proceed as follows:

a. Rotate drum in normal direction by hand until leading end of helix wire is about to disappear under drum.

b. Starting from middle, lift wire out of retaining clips. Work toward leading end.

c. Unhook leading end of helix wire from cam and, rotating drum by hand in normal direction, lift off wire. Work toward trailing end.

d. Unhook trailing end of helix wire and remove.

e. Hook end of replacement helix wire on leading end of helix strip.

f. Rotate drum by hand in normal direction and, while guiding wire, hook wire to trailing end of helix strip.

g. Continue rotation by hand and secure wire in each retaining clip. Check that wire is securely seated in every retaining clip.

4-5.4 Helix Strip Replacement. To replace the helix strip, expose the drum as in cleaning and proceed as follows:

a. Remove helix wire (paragraph 4-5.3).

b. Turn cam at leading end of helix strip 1/2 turn with screw driver and free strip from end of drum.

c. Slowly rotate drum by hand in normal direction and lift strip from

drum over entire length.

d. Turn cam at trailing end of helix strip 1/2 turn with screw driver to free strip completely from drum.

e. Hook end of helix strip over cam on leading end of drum and rotate cam about 1/8 turn.

f. Rotate drum slowly by hand in normal direction and lay helix strip securely into groove.

g. Hook end of helix strip over cam at trailing end of drum and tighten cam by turning 1/2 turn.

h. Continue to rotate drum and tighten leading end cam.

i. Install helix wire (paragraph 4-5.3).

4-5.5 Loop Electrode Replacement. To replace loop electrode, open recorder cover and proceed as follows:

a. Remove back tension assembly. This is plate with rubber gasketing around edges which can be slid out by pulling toward front of recorder.

b. In upper left corner of loop assembly, find loop drive mechanism. Note position of lock lever (bar with three teeth which alternately engage and disengage loop electrode). If teeth are engaged with loop electrode, run recorder at 60rpm until disengaged and then switch recorder to STBY.

c. Remove loop electrode by pulling from slot.

d. Insert replacement loop electrode into slot and seat securely.

e. Replace back tension assembly. Turn rubber gasketing down and align with gasketing on frame of loop assembly.

f. Close cover and check adjustment of electrode by recording phasing signal, noise, or other signal which marks across scan line.

g. If no marking is obtained, or adjustment is desired, locate loop stop adjusters (one on either side of paper bed in front of loop). These lower or raise loop electrode relative to helix wire.

h. With signal to recorder, raise loop until no marks are made. Then lower loop, using right and left adjusters alternately in small steps until full scan line is obtained.

i. Lock adjusters. Do not lower loop beyond position required to obtain full scan line.

SECTION V

PARTS LIST

This section and Appendix A contain parts lists for the facsimile recording system. Refer to Appendix A for a list of replacement parts for the receiver. Table 5-1 is the parts list for the converter and Table 5-2 is the parts list for the recorder.

Table 5-1. Parts List for Facsimile Converter, RCV-500

SYMBOL	DESCRIPTION
A0001	LIMITER ASSEMBLY
A0008	DISCRIMINATOR ASSEMBLY
	CAPACITORS:
C201	.01 mf, 400 v.
C202	1.0 mf, 100 v.
C203	.01 mf, 400 v.
C204	.01 mf, 400 v.
C205	.01 mf, 400 v.
C206	.01 mf, 400 v.
C207	.01 mf, 400 v.
C208	.01 mf, 400 v.
C209	20 mf, 350 v.
C210	50 mf, 50 v.
C211	50 mf, 50 v.
CR201	GERMANIUM DIODE, IN2094
CR202	GERMANIUM DIODE, IN2094
CR203	GERMANIUM DIODE, IN2094
CR204	GERMANIUM DIODE, IN2094
F201	FUSE, 1A SLO BLO, 3 AG
L201	VARIABLE INDUCTOR, BOLT L4010
L202	VARIABLE INDUCTOR, BOLT L4010
Q201	GERMANIUM TRANSISTOR, 2N1304
	RESISTORS: FIXED COMPOSITION, 1/2 W, ± 10% UNLESS OTHERWISE SPECIFIED
R201	10,000 OHMS
R202	10,000 OHMS, VARIABLE, 2W
R203	100,000 OHMS
R204	100,000 OHMS
R205	4,700 OHMS
R206	1 MEGOHM
R207	1 MEGOHM
R208	470,000 OHMS

R209	470,000 OHMS
R210	39,000 OHMS, 1W
R211	470 OHMS
S201	SWITCH, TOGGLE, SPDT
T201	INPUT TRANSFORMER, BOLT T1869
T202	POWER TRANSFORMER, BOLT T1864
V201	VACUUM TUBE, EM/84
V202	VACUUM TUBE, EM/84

Table 5-2. Parts List for Facsimile Recorder, MR-100

SYMBOL	DESCRIPTION
A1010	AMPLIFIER ASSEMBLY, BOLT S-1010
A0101	TUNING FORK OSCILLATOR, AMER. TIME PRODS. TYPE 1 BOL-32L4BV
	CAPACITORS:
C301	1 mf, 100 v.
C302	500 mf, 15 v.
C303	4 mf, 15 v.
C304	500 mf, 15 v.
C305	10 mf, 50 v.
C306	500 mf, 15 v.
C307	34,000 mf, 15 v.
C308	20,000 mf, 25 v.
C310	3 mf, 400 v.
C311	3 mf, 400 v.
CR301	RECTIFIER, FULL WAVE BRIDGE, FW600
CR302	RECTIFIER, FULL WAVE BRIDGE, 3V1V1A1A2
F301	FUSE, 2A SLO BLO, 3AG
F302	FUSE, 2A SLO BLO, 3AG
I301	INDICATOR LAMP, GE #258
K301	SENSITIVE RELAY, SPDT, BOLT KSM5
L301	FILTER CHOKE, BOLT L1836
Q301	GERMANIUM TRANSISTOR, 2N1305
Q302	GERMANIUM TRANSISTOR, 2N669
Q303	GERMANIUM TRANSISTOR, 2N669
Q304	GERMANIUM TRANSISTOR, 2N669
Q305	GERMANIUM TRANSISTOR, 2N2082
Q306	GERMANIUM TRANSISTOR, 2N2082
Q307	GERMANIUM TRANSISTOR, 2N669
Q308	GERMANIUM TRANSISTOR, 2N669
Q309	GERMANIUM TRANSISTOR, 2N669

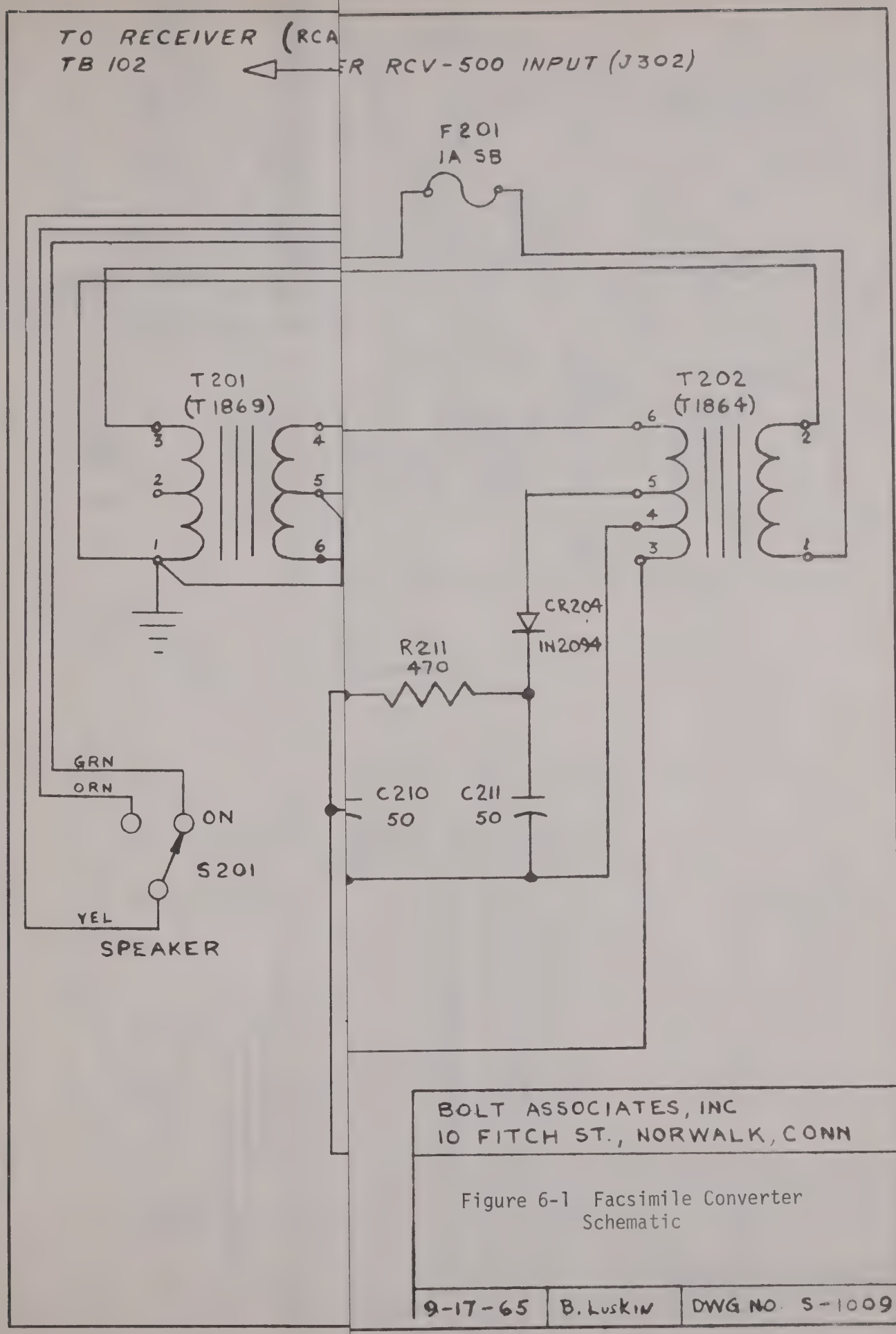
RESISTORS: FIXED COMPOSITION, 1/2W, ± 10% UNLESS OTHERWISE SPECIFIED

R301	100,000 OHMS
R302	100,000 OHMS
R303	4,700 OHMS
R304	27 OHMS
R305	47,000 OHMS
R306	47,000 OHMS
R307	47 OHMS
R308	4,700 OHMS
R309	27 OHMS
R310	2 OHMS, 3W, ± 10%
R311	2 OHMS, 3W, ± 10%
R312	47,000 OHMS
R313	47 OHMS
R314	47,000 OHMS
R315	27 OHMS
R316	2 OHMS, 3W, ± 10%
R317	2 OHMS, 3W, ± 10%
S301	SWITCH, TOGGLE, DPST
S302	SWITCH, PUSH BUTTON, DPDT
S303	SWITCH, ROTARY SELECTOR, 4 POLE, 4 POS.
T301	DRIVER TRANSFORMER, BOLT T1861
T302	DRIVER TRANSFORMER, BOLT T4028
T303	OUTPUT TRANSFORMER, BOLT T1862
T304	DRIVER TRANSFORMER, BOLT T1861
T305	OUTPUT TRANSFORMER, BOLT T1858
T306	POWER TRANSFORMER, BOLT T1855
A0729	SYNC MOTOR ASSEMBLY, BOLT R-0729
A9000	MECH UNIT ASSEMBLY, ALDEN 311DA
X9011	RECORDING PAPER ROLL
X9101	LOOP ELECTRODE (BLADE)
X9102	HELIX STRIP
X9103	HELIX WIRE

SECTION VI

SCHEMATIC DIAGRAMS

This section presents schematic diagrams for the converter and the recorder. Refer to Appendixes A and B for modified wiring of the receiver. Figures 6-1 and 6-2 show the wiring for the converter and the recorder.


TO RECEIVER (RCA
TB 102
ER RCV-500 INPUT (J302)
F201
1A SB
T201
(T1869)
T202
(T1864)
CR204
IN2094
R211
470
C210
50
C211
50
GRN
ORN
ON
S201
YEL
SPEAKER
BOLT ASSOCIATES, INC
10 FITCH ST., NORWALK, CONN
Figure 6-1 Facsimile Converter Schematic
9-17-65
B. Luskin
DWG NO S-1009

TO RECEIVER (RCA CRM-R1A)
TB 102

P201
TO RECORDER RCV-500 INPUT (J302)

TB201

F201
1A SB

+20V

T201
(T1869)

A0001

R201
10K

A0008
LEVEL
OUT
IN
COM

R202
10K

R203
100K

R204
100K

.01
C201

Q201
2N1304

C202
4.7K
R205

T202
(T1864)

CR204
IN2094

R211
470

CR203
IN2094

R208
470K

+150V

C209
20

R210
39K

C210
50

C211
50

GRN
ORN
ON
S201
YEL
SPEAKER

C203
.01

L201

CR201
IN2094

C205
.01

C207
.01

R206
1M

V201 EM/84
WHITE

V202 EM/84
BLACK

C208
.01

R207
1M

C206
.01

C204
.01

L202

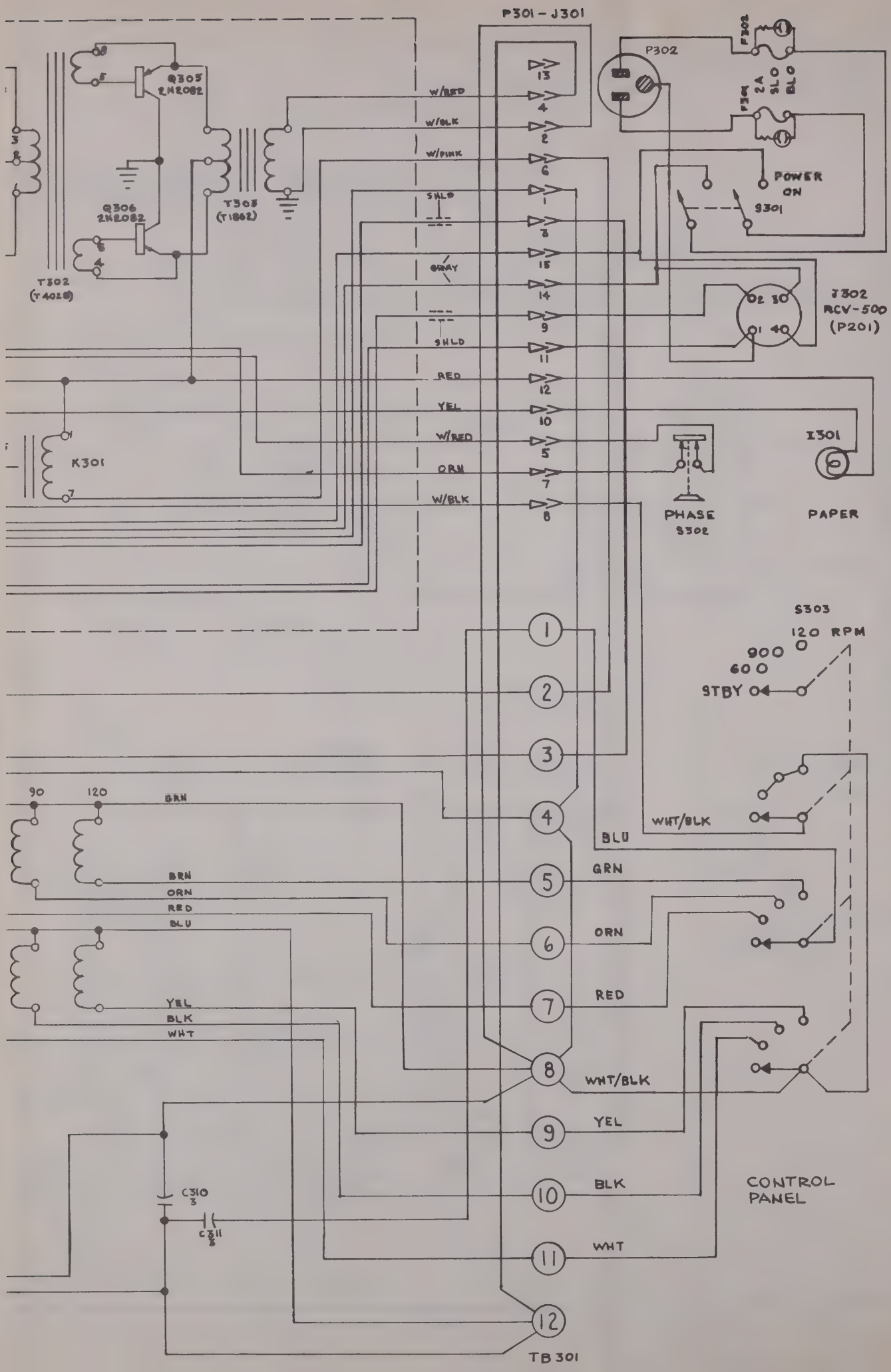
CR202
IN2094

R209
470K

BOLT ASSOCIATES, INC
10 FITCH ST., NORWALK, CONN

Figure 6-1 Facsimile Converter Schematic

9-17-65	B. Luskin	DWG NO S-1009


P301 - J301
P302
FUSE 2A SLO BLO
POWER ON
S301
J302 RCV-500 (P201)
Q305 2N2082
Q306 2N2082
T303 (T1862)
T302 (T4028)
K301
W/RED
W/BLK
W/PINK
SHLD
GRAY
RED
YEL
W/RED
ORN
W/BLK
I301
PHASE S302
PAPER
S303
120 RPM
900
600
STBY
90
120
GRN
BRN
ORN
RED
BLU
YEL
BLK
WHT
WHT/BLK
BLU
GRN
ORN
RED
WHT/BLK
YEL
BLK
WHT
C310
C311
CONTROL PANEL
TB 301

APPENDIX A

RADIO RECEIVER INSTRUCTION BOOK

This appendix contains Instruction Book, 1B-30690-1, Radio Corporation of America. This book, as modified by Appendix B, provides information for the receiver in the facsimile recording system.

AMPLIFIER ASSEMBLY
A1010

FREQUENCY ADJUST

A0101
TUNING FORK OSC.

R301 100K
Q301 2N1305
R303 4.7K
C303 4
R305 47K
Q302 2N669
R306 47K
R307 47
C305 10
T301 (T1861)
R308 4.7K
C304 500
R309 27
Q303 2N669
R310 2
R311 2
Q304 2N669
T302 (T402B)
Q305 2N2082
Q306 2N2082
T303 (T1862)
C301 1
R302 100K
R304 47
C302 500
+12V

R312 47K
R313 47
C306 500
R315 27
Q307 2N669
R314 47K
T304 (T1861)
Q308 2N669
R316 2
R317 2
Q309 2N669
T305 (T1759)
CR301 FW600
L301
C307 34K
C308 20K
CR302 3V1B1A1A2
T306 (T1855)
K301

P301 - J301
W/RED
W/BLK
W/PINK
SHLD
6WAY
SHLD
RED
YEL
W/RED
ORN
W/BLK

P302
P303
P304
2A SLO BLO
POWER ON
S301
T302 RCV-500 (P201)
I301
PAPER
PHASE S302

S303
120 RPM
90
60
STBY

MECH UNIT ASSEMBLY A9000

LOOP DRIVE MOTOR
Z9101 LOOP ELECTRODE
HELIX ELECTRODE Z9102 Z9103
SYNC MOTOR ASSEMBLY A 0729
PAPER ROLL Z9011
PAPER SWITCH

60 90 120 GRN
BRN
ORN
RED
BLU
YEL
BLK
WHT

C310 3
C311 8

WHT/BLK
BLU
GRN
ORN
RED
WHT/BLK
YEL
BLK
WHT
CONTROL PANEL

TB 301

BOLT ASSOCIATES, INC
10 FITCH ST., NORWALK, CONN.

Figure 6-2 Facsimile Recorder Schematic

12-9-65 | B Lickw | DWG NO 5-1010

APPENDIX A

RADIO RECEIVER INSTRUCTION BOOK

This appendix contains Instruction Book, 1B-30690-1, Radio Corporation of America. This book, as modified by Appendix B, provides information for the receiver in the facsimile recording system.

INSTRUCTION BOOK

Radiomarine®

RADIO RECEIVER
2-30 Mc/s

Type

CRM-R1A

RADIO CORPORATION of AMERICA

RCA INTERNATIONAL DIVISION
NEW YORK 20, N. Y., U. S. A.

RADIOMARINE PRODUCTS DEPARTMENT
CAMDEN 2, N. J.

TRADEMARK ® REGISTERED
MARCA REGISTRADA

PRINTED IN U. S. A.
BR674

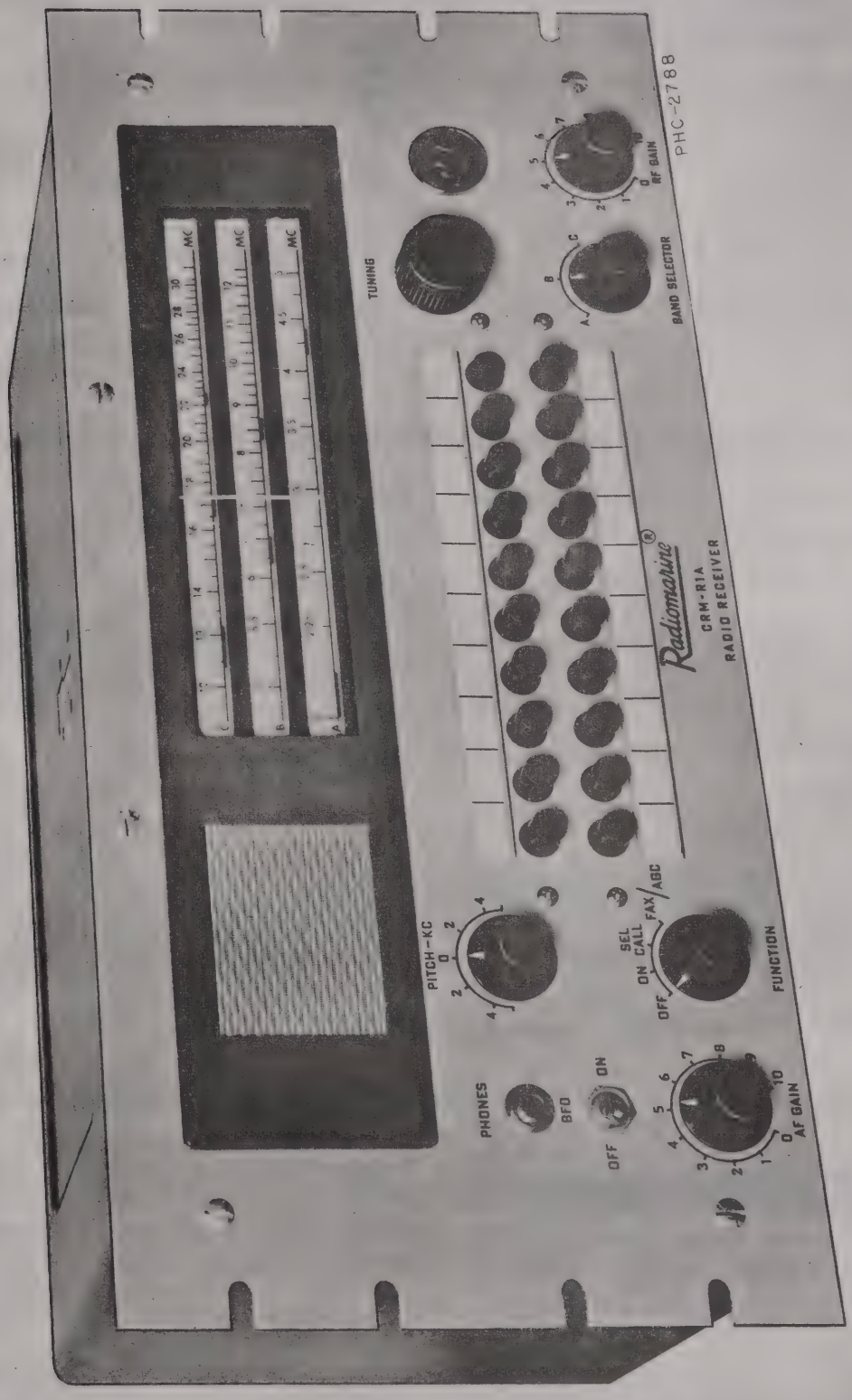


Figure 1. Type CRM-R1A Radio Receiver

TECHNICAL DATA

ELECTRICAL SPECIFICATIONS

Frequency Range:

Band	*Frequency*
A	2 to 5 Mc/s
B	5 to 12.5 Mc/s
C	12 to 30 Mc/s

Power Requirements ..... 115 volts dc or 115 volts ac, 50/60 cycles, Single Phase

Terminals are provided so that the power to the external converter can be turned on and off automatically by the receiver power switch.

Power Consumption ..... Approx. 50 watts

Sensitivity:

A 3 microvolt signal fed through a standard dummy antenna will give a signal-to-noise ratio of at least 6 db at an audio output of 500 milliwatts.

A similar signal will give a signal-to-noise ratio of at least 10 db for A-1 reception.

Selectivity (overall):

	Ratio: Input voltage off resonance to voltage at resonance	*Total Bandwidth*
with standard 3.1 kc/s filter (MI-555526-1)	2.0 (6 db)	3.1 kc/s ±10%
	1000.0 (60 db)	7.0 kc/s
with optional 6 kc/s filter (MI-555526-2)	2.0 (60 db)	6.0 kc/s ±10%
	1000.0 (60 db)	12.5 kc/s

AGC-Output within 15 db for Input of 10 microvolts to 100,000 microvolts (80 db)

Image Rejection:

Greater than 60 db from 2 Mc/s to 25 Mc/s

I-F Rejection:

Both 1700 kc/s and 455 kc/s, I-F Greater than 100 db at 9000 kc/s

Audio Output:

750 milliwatts maximum undistorted output. Maximum output 1.25 watts.

Radiation:

Less than 400 micro-microwatts in compliance with FCC Rule 83.135

Antenna Input Impedance:

a. High impedance input for use when connected to common antenna with other receiving equipment.

b. Low impedance input for use when installed with separate antenna.

MECHANICAL SPECIFICATIONS

Width	19 "
Height	8¾"
Depth	10⅜"
Weight	19½ pounds

TUBE COMPLEMENT

Symbol No.	*Type*	*Function*
V101	12BA6	RF Amplifier
V102	12BE6	Mixer
V103	19X8	Converter
V104	12BA6	1st I-F Amplifier
V105	12BA6	2nd I-F Amplifier
V106	12BA6	3rd I-F Amplifier
V107	12AL5	Detectors/AGC
V108	12AX7	AF Amplifier
V109	50C5	Power Amplifier
V110	6BJ6	Local Oscillator
V111	6BJ6	BFO

FUSE COMPLEMENT

Symbol	*Rating*
F101	1 Ampere
F102	1 Ampere
F103	3 Ampere
F104	3 Ampere

DESCRIPTION

General

The CRM-R1A is a double conversion, highly selective, stable (crystal controlled) communications receiver utilizing separate RF and AF GAIN Controls. Design features make it suitable for table mounting and accessory brackets are available for rack mounting if desired.

The CRM-R1A is designed for communications aboard a ship, or on shore. The unit is a twenty channel crystal controlled receiver with a frequency range of 2 megacycles to 30 megacycles. The CRM-R1A receiver is highly selective, containing a steep sided plug-in mechanical filter which has a bandwidth of 3.1 kc/s for CW reception. However a mechanical filter with a bandwidth of 6.0 kc/s and a center frequency of 455 kc/s may be directly substituted for the filter supplied if the CRM-R1A is desired for use as a radiotelephone receiver.

Provisions for AGC are also incorporated in this receiver. By setting the FUNCTION switch to the FAX/AGC position, AGC becomes effective.

On the front of the receiving cabinet, there are two rows of push buttons. Each row contains ten push-buttons for channel selections. The buttons are interlocked so that depressing any button on either row will automatically release a depressed button. A blocking mechanism prevents simultaneous depression of any two buttons in the same row.

Weather Map

When the CRM-R1A is used in the RCA Facsimile Weather Map Receiving System, it converts the radio waves to a usable audio signal which is injected into the facsimile recorder. The recorder accepts and amplifies the signals and converts them back into corresponding density variations on a recording sheet. The resultant is a completed weather map, sea condition chart, graph, document or other transmitted intelligence.

Additional information on using the CRM-R1A receiver in Facsimile Weather Map Receiving System may be found in instruction book IB-30697.

Selective Calling

The CRM-R1A is also designed for use in the RCA Selective Calling System (Radiomarine Type CRM-S2A) whereby a particular subscriber, and only that subscriber out of a total list of subscribers, can be alerted by an alarm. The alarm consists of a buzzer that is mounted in a small metal box which may be located where desired. In order to accomplish this, each subscriber in a system is assigned a different calling code number. It is the responsibility of the subscriber's code receiving equipment (or decoder) to differentiate between all the codes, selecting only the correct one, and upon reception of this code, sound an alarm informing the subscriber that he is being called.

When the CRM-R1A is used in the selective calling system, the CRM-R1A demodulates the radio frequency carrier and sends the resulting modulation to the selective calling decoder unit. It also serves the function of switching the power to the decoder on and off. For additional information pertaining to Selective Calling, refer to IB-30688-P.

INSTALLATION

General

The installation of the CRM-R1A receiver consists mainly of making the proper Power Supply and Antenna connections.

Power Supply

The Power Supply connections are as follows:

1. For 115 volt DC supply, connect terminals 6 and 7 of TB102, to the ship's power source taking care to observe the polarity as shown on schematic diagram, (Figure 4). The positive conductor connects to terminal 7. Connect the ship's ground to that terminal marked GND on the rear apron of the receiver chassis.

2. For 115 volt AC supply, connect terminals 6 and 7 of TB102 to the ship's power source. Polarity designations need not apply. Connect the ship's ground to the terminal marked GND on rear apron of the receiver chassis.

3. For supply voltages other than 115 volts DC, such as 12 volts, 32 volts, 24 volts, and 230 volts DC, it is necessary to install a separate converter to deliver 115 volts to the CRM-R1A. For 230 volts AC, a transformer is required. Where such a converter is used, proceed with installation as follows:

a. Connect one side of the input power line, (of the converter) to the terminal 8 of TB102.

b. Connect the other side of the input power line (of the converter) to one side of the ship's line.

c. Connect terminal 9 of TB102 to the other side of the ship's line.

d. Connect the converter output power terminals to terminals number 6 and 7 of TB102, observing polarity if the converter output voltage is DC.

NOTE: The connections performed under step 3 above, causes the converter power to switch on and off with the receiver power. For detailed instructions on converter connections, refer to IB-30688-P for Selective Calling Systems and IB-30697 on Facsimile weather Map Receiving System.

ANTENNA

The CRM-R1A receiver has antenna input terminals for high and low impedance. When the CRM-R1A is used with its own Antenna, the low impedance terminal should be used. Should the low impedance terminal be used, connect the antenna to the terminal marked LO on ANTENNA terminal board TB101, and connect a ground to the terminal marked GND on the same board.

The high impedance input is used when the CRM-R1A is connected to a common antenna with other receiving equipment. For high impedance input, connect antenna to terminal marked HI on ANTENNA terminal board TB101, and a ground to the terminal marked GND on the same board.

OPERATION

Operation Procedure

a. Turn FUNCTION switch to the ON position. The dial will light, indicating that power is on.

b. Depress the push-button for the crystal of the desired frequency or channel. The buttons appear in two rows. Each row has ten buttons and there is a marking card above each button indicating the frequency and station.

c. Turn BAND SELECTOR switch to the band (A, B or C) which includes the desired frequency. The dial light will illuminate the band selected.

d. Advance RF GAIN control to maximum gain position (full clockwise to position 10) and the AF GAIN control to a convenient setting where some noise is audible.

e. Adjust TUNING to bring the dial point to the desired frequency. Run dial pointer back and forth in region of the *desired* frequency to peak RF circuit *on noise.*

> NOTE: The image frequency is 3.4 Mc/s above the signal frequency. It is, therefore, possible on bands B and C to tune the RF circuits to the image frequency. Thus, in tuning in *on noise,* the dial reading should be observed so that the RF stages are tuned to the desired frequency.

f. Switch BFO toggle switch to the ON position. Adjust PITCH control for desired audio tone (if signal is present). Adjust RF GAIN and AF GAIN for a comfortable listening level.

g. To change channels, depress the proper push-button, turn BAND SELECTOR to proper band, and adjust TUNING to bring dial point to the desired frequency.

Automatic Gain Control (AGC)

The CRM-R1A receiver utilizes AGC to minimize fading and overloading. For use of AGC, the FUNCTION switch must be set in the FAX/AGC position. In this position, fading is held to a minimum and AGC will prevent overload from an input of 1 microvolt to 1 volt.

Crystals

If when selecting a crystal for the CRM-R1A, the operating frequency is between 2 Mc/s to 14.3 Mc/s, one must add 1.700 Mc/s to the operating frequency to obtain the crystal frequency.

Example: Operating frequency = 8.630 Mc/s
Crystal frequency = 8.630 + 1.700 = 10.330 Mc/s

For any operating frequency from 14.3 Mc/s to 30 Mc/s, add 1.700 Mc/s to the operating frequency and divide result by 2 in order to obtain crystal frequency.

Example: Operating frequency 22.617 Mc/s
To obtain crystal frequency:
22.617 + 1.700 = 24.317 Mc/s
24.317 ÷ 2 = 12.1585 Mc/s
Crystal frequency = 12.1585 Mc/s

Crystals should be ordered per specifications on RCA drawing 3402434.

Trimmer capacitor C160 is preset at the factory to provide the required 32 mmf load capacitance for the crystal oscillator circuit. For cases where extreme accuracy is required at the high frequencies, the crystal oscillator frequency can be "pulled" by varying C160. Rotating C160 through 360° will vary the frequency approximately 250 cps at operating frequencies of 15 Mc/s and higher.

Inserting New Crystals

To insert a new crystal, open the lid on top of the receiver cabinet by depressing the button furthest from the front panel. The new crystal can then be inserted in any of the crystal sockets, independent of crystal frequency or socket position. See Figure 2.

The position of the push-button corresponds to the position of its associated crystal socket. For example, the fourth push-button from the left in the upper row is the button for the fourth crystal socket from the left in the upper row.

When a new crystal is inserted, write the desired information on the front panel card above the appropriate push-button. The card is a plastic material which takes to the writing of pencil, pen or ball-point without scratching or marring. The writing is readily removable with eraser or damp cloth.

Since the receiver is crystal controlled, the receiver can be tuned without changing the audio tone (for CW signals). However, when switching from one channel to another, some change in the audio tone will be observed due to tolerances in the transmitter and receiver crystals. Slight adjustment of the PITCH control will restore the desired audio tone.

When phones are plugged in, the loudspeaker is automatically silenced. The receiver will operate without auxiliary equipment on either 115V AC or 115V DC. Be certain to ground the receiver chassis. In some AC installations, hum may be reduced by reversing the power plug.

TUNING AND ADJUSTMENTS

455 I-F Circuit Alignment

The following procedure is recommended for aligning the 455 kc/s i-f Amplifier: (Refer to Figures 2 and 3 of this instruction book.)

1. Connect a 455 kc/s signal generator through a .01 mfd capacitor to pin 1 of tube V104 (12BA6). The ground lead of the signal generator should be connected to the receiver chassis. Connect an AC voltmeter across the loudspeaker terminals.

2. From the signal generator, feed in a fairly strong modulated signal (modulation frequency and percentage is not critical) to give approximately a 1 volt reading on the output voltmeter. Tune the primary (bottom core) of Z104 until the output voltage is peaked, keeping the output voltage at approximately 1 volt by cutting down on the input signals as the output voltage rises.

NOTE: The secondary (top core) of Z105 is only used for selective calling reception and can be tuned *only* by connecting a *DC* vacuum tube voltmeter across terminals 2 and 3 of TB102. It need not be retuned for CW reception.

Following the same procedure outlined above, tune the secondary (top core) and the primary (bottom core) of Z103, and then the secondary (top core) and the primary (bottom core) of Z102. Be careful that the signal generator output is reduced to keep the output meter reading at approximately 1 volt.

1700 KC/S I-F Circuit Alignment

The following procedure is recommended for aligning the 1700 kc/s i-f amplifier:

1. Connect a 1700 kc/s signal generator through a .01 mfd capacitor to pin 7 of the mixer tube V102. The ground lead of the signal generator should be connected to the receiver chassis. Connect an AC Voltmeter across the loudspeaker terminals. Adjust AF GAIN so that the AC voltmeter reading does not exceed 0.4 volt with zero input signal.

2. Feed in a modulated 1700 kc/s signal. (It is not essential that the generator be accurate, since the crystal controlled oscillator and the mechanical filter can be used to guide the generator adjustment.) Peak the output voltage by adjusting the secondary (top core) and the primary (bottom core) of T104. Keep the output voltage at approximately 1 volt by backing off the AF GAIN control as the circuits are peaked.

RF Section Alignment

I-F Wave Trap Adjustment

Connect a 1700 kc/s signal generator through a 100 mmf capacitor to the LO terminal of ANTENNA terminal board TB101. Connect the ground lead of the signal generator to the receiver chassis. Turn the BAND SELECTOR switch to position A. Set the dial pointer at approximately 2 mc on Band-A. Connect an AC voltmeter across the loudspeaker terminals.

Feed in a strong modulated 1700 kc/s signal, sufficient enough to deflect the output voltmeter. Adjust the core of L111 for a dip in the output meter reading. When the dip occurs, increase signal strength to be sure that maximum null has been obtained.

R-F Circuit Alignment

Connect a 2–30 Mc/s frequency range signal generator through a 100 mmf capacitor to the LO terminal of the ANTENNA terminal board TB101. Connect the ground lead of the signal generator to the receiver chassis. Turn BAND SELECTOR switch to position B. The bottom plate should be on the receiver chassis. Connect an AC voltmeter to the loudspeaker terminals.

a. Set the dial pointer to a calibrated frequency position (toward the low end of the dial) for which a crystal is available. For example, use any crystal for an operating frequency in the 6Mc/s radiotelegraph band, and set the pointer properly for the chosen frequency. Feed in signal at proper frequency and adjust the secondary (bottom core) and the primary (top core) of T102 to the peak output voltmeter reading. Then peak L102.

NOTE: Throughout the RF circuit alignment procedure, RF GAIN should be kept at the maximum clockwise position. AF GAIN should be backed off so that the output meter reading does not exceed 0.4 volt with zero input signal. The signal generator output should be kept at a level that gives an output meter reading of approximately 1 volt, when a signal is fed in. The BFO toggle switch should be in the OFF position.

b. Set the dial pointer to a calibrated frequency position (toward the high end of the dial) for which a crystal is available.

In the field, crystals for operating frequencies in the vicinity of 12 Mc/s may not normally be available. However, the image frequency for channels in the 8 Mc/s radiotelegraph band fall in the 12 Mc/s region. For example: Take an operating frequency of 8.630 Mc/s. For this frequency, the image frequency is 8.630 + 3.400 = 1200 Mc/s.

Feed in signal at the proper frequency and adjust trimmer capacitors (C112, C109 and C105 to a peak reading on the output meter.

c. Repeat steps A and B until circuits are tracked.

d. Turn BAND SELECTOR switch to position A. Set dial pointer to a calibrated frequency position (toward the low end of the dial) for which a crystal is available. Feed in a signal at the proper frequency. Peak the secondary (top core) and the primary (bottom core) of T101, then peak L101.

e. Turn BAND SELECTOR switch to position C.

Set dial pointer to a calibrated frequency position (toward the low end of the dial) for which a crystal is available. Feed in a signal at the proper frequency. Peak the secondary (top core) and the primary (bottom core) of T103; then peak L103.

The foregoing procedure aligns the RF circuits when the CRM-R1A is installed with separate antenna feeding into the LO terminal of ANTENNA terminal board TB101.

When connected to the common antenna with other receiving equipment, the HI terminal of TB101 is used. The same RF circuit alignment procedure should be followed with the following exceptions:

1. The CRM-R1A should be connected to the common antenna and to the other receiving equipment with which it is being used during RF circuit alignment.

2. The signal generator should be connected through a 100 mmf capacitor to the HI terminal of the ANTENNA terminal board TB101.

BFO Adjustment

Connect a 455 kc/s signal generator through a .01 mfd capacitor to pin 1 of V104 (12BA6). The ground lead of the generator should be connected to the receiver chassis. Throw BFO toggle switch, S104, to the ON position. Set PITCH control capacitor, C183, to mid-capacity (plates half-meshed) and pointer to zero. Adjust coil, L108, to a zero beat with 455 kc/s signal.

NOTE: *BFO FUNCTION;* clockwise rotation of the PITCH CONTROL (from zero) will lower the BFO frequency (455 kc/s). With 10 microvolts input (400 c/s modulation at thirty percent), the R-F GAIN set at maximum, and the selector switch in the FAX/AGC position, adjust AF gain for 50 milliwatts output. Turn BFO on (modulation off), and the output should increase at least 5.0 db for a 400 c/s beat note.

MAINTENANCE

With ordinary care a minimum of service will be required to maintain the CRM-R1A receiver. Check tubes periodically. Tube failure can be anticipated by keeping a log of tube life, and replacing tubes when the need is indicated by the log or when reduced output is apparent. The most frequent cause of failure in low power and receiving-type tubes is gradual loss of emission, due to use; such a condition is easily recognized if a record has been kept on each tube. It is suggested that a spare set of tubes be kept on hand for replacement.

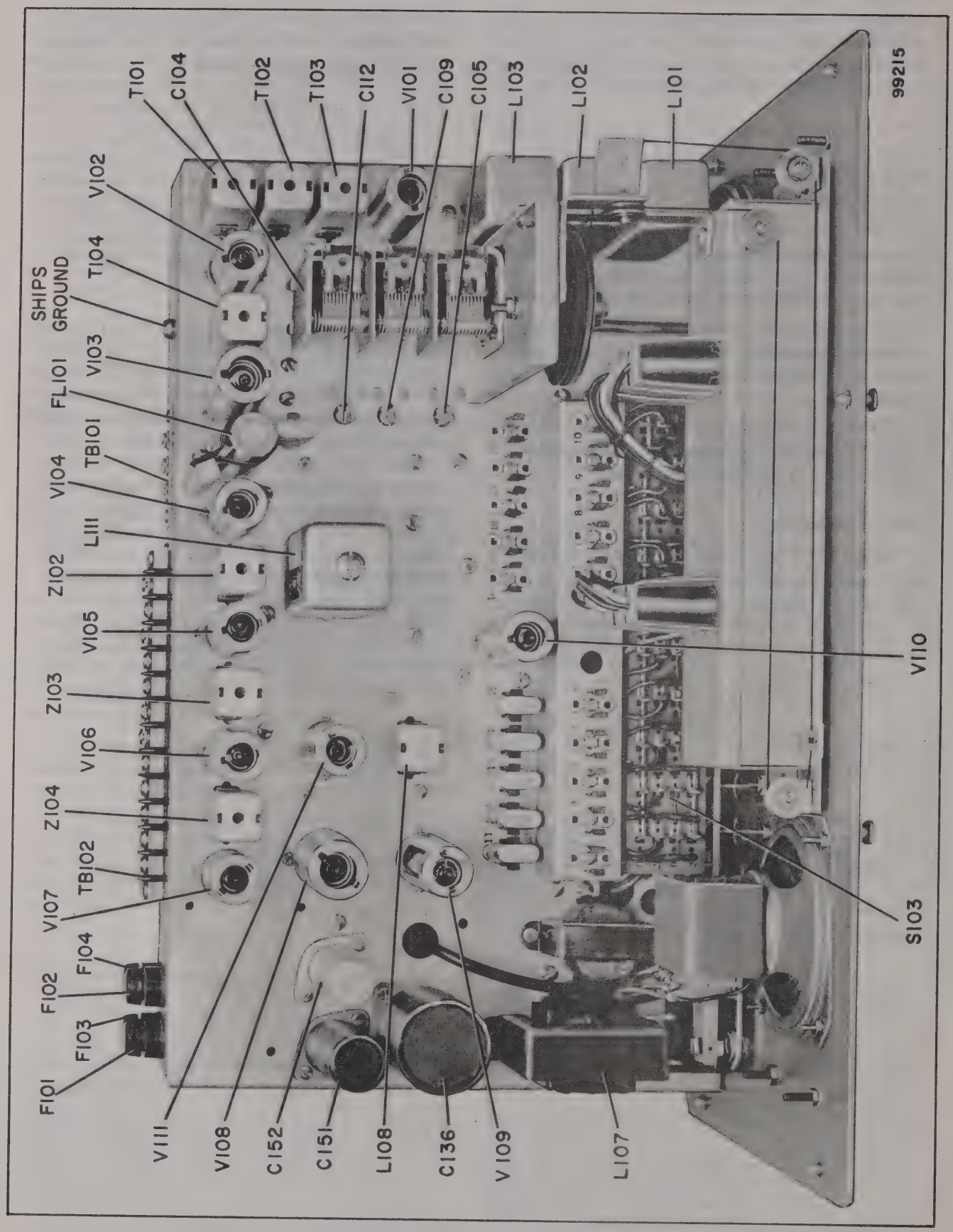


Figure 2. Identification of Parts, Top View of Chassis, CRM-R1A Receiver

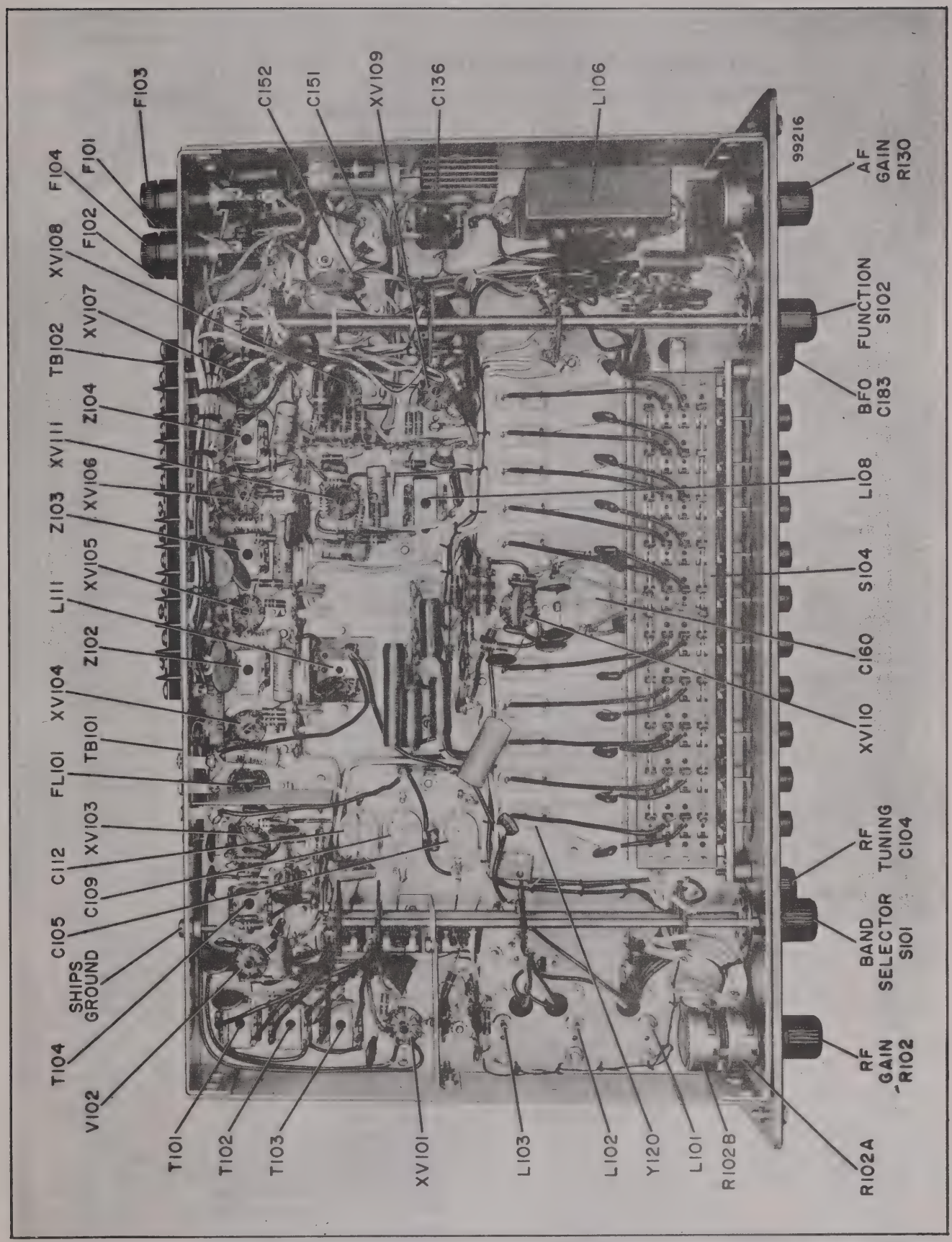


Figure 3. Identification of Parts, Bottom View of Chassis, CRM-R1A Receiver

REPLACEMENT PARTS

Symbol No.	Stock No.	Drawing No.	Description
Type CRM-R1A RADIO RECEIVER (MI-555515)			
			CAPACITORS:
C101	073-925	1220079-1	5 pf, 600 v.
C102	073-079	990490-133	270 pf, 500 v.
C103	066-0022	990491-251	1500 pf, 500 v.
C104	078-0026	1249361-1	Air Var., 3 section, max. 323.1 pf
C105	078-014	728680-1	Variable, 1.5-7.0 pf
C106	074-0076	1221050-1	.01 μf, 150 v.
C107	074-171	990167-19	.01 μf, 500 v.
C108			Same as C103
C109	078-015	728680-3	Variable, 3-13 pf
C110			Same as C107
C111			Same as C103
C112			Same as C109
C113	073-397	990167-11	470 pf, 500 v.
C114 to C117			Same as C107
C118, C119	073-058	990490-121	82 pf, 500 v.
C120	074-554	990167-13	1000 pf, 500 v.
C121			Same as C118
C122	073-155	990490-209	27 pf, 500 v.
C123			Same as C107
C124			Same as C113
C125	073-067	990490-125	120 pf, 500 v.
C126			Same as C107
C128 to C133	074-0031	8909924-16	0.1 μf, 200 v.
C134	073-057	990490-119	68 pf, 500 v.
C135			Same as C120
C136	077-0017	442908-15	Electrolytic, 20-20-40-20 μf, 150/25/150/150 w.
C137			Same as C107
C138			Same as C113
C139			Same as C107
C140	074-0007	8811182-11	.02 μf, 500 v.
C141 to C146			Same as C107
C147 to C150	074-0025	8909924-17	.22 μf, 200 v.
C151, C152	077-0018	86028-11	Electrolytic, 40 μf, 150 v.
C153	074-0039	8909924-18	.47 μf, 200 v.
C154	073-0034	990489-202	10 pf, 500 v.
C155			Same as C106
C156			Same as C122
C157			Same as C107
C158	073-103	990491-147	1000 μf, 500 v.
C159			Same as C107
C160	078-160	3402760-208	Variable, 7-25 pf
C161	073-083	990490-139	470 pf, 500 v.
C162 to C171	073-0005	990491-235	330 pf, 500 v.
C172 to C181	073-079	990490-233	270 pf, 500 v.
C182	073-103	990491-247	1000 pf, 500 v.
C183	078-0029	727819-102	Variable, 4-23 pf
C184			Same as C172
C185			Same as C182
C186	073-785	990491-255	2200 pf, 500 v.
C187			Same as C128
C188	073-079	990490-223	100 pf, 200 v.
C189 to C191			Same as C128
C192	074-0075	1220079-2	0.1 μf, 50 v.
C193 to C197			Same as C106
C198	066-380	990490-229	180 pf, 300 v.
C199, C200			Part of Z102
C201, C202			Part of Z103
C203, C204			Part of Z104
C205, C206			100 pf, 100 v., Part of Z105
C207, C208			100 pf, 100 v., Part of Z106
C209			Same as C107
C210	073-008	942454-87	3.3 pf, ±10%, 500 v.

REPLACEMENT PARTS

Symbol No.	Stock No.	Drawing No.	Description
C211	077-0001	442901-61	Electrolytic, 50 μf, 150 v.
CR101	263-240	1220079-3	Rectifier - Selenium, 150 ma, 156 v. Input rms
DS101 - DS106	202-253	990158-12	Lamp, Dial, Min. Bayonet, 6-8 v., 150 ma, Type 47
F101, F102	777-2058	990157-8	Fuse, 1 amp., 250 v.
F103, F104	777-1970	990157-11	Fuse, 3 amp., 250 v.
FL101	136-0012	1214248-1	Filter, Mechanical
J101	259-0032	845648-3	Jack, short frame
L101	350-0349	1239459-501	Coil - Radio Freq., Input, Band A
L102	350-0351	1239459-502	Coil - Radio Freq., Input, Band B
L103	350-0352	1239450-503	Coil - Radio Freq., Input, Band C
L104, L105	350-0074	1215560-4	Coil - Choke, Hash Filter, 22 μh
L106, L107	350-585	B-180-1	Coil - Choke, 5H, 140 ohms, 80 ma
L108	350-0353	1219540-5	Coil - B. F. O. - K-Train, exo-5316
L109	348-135	1220079-4	Coil - Choke, 500 μh, 75 ma
L110	350-0364	X-318-2	Coil - Peaking, 51.8 μh
L111	350-0358	1220079-8	Coil - Trap, 48.8 μh
L112	350-0363	3401774-1	Coil - Radio Frequency Tuning Band C
LS101	308-213	1215404-1	Loudspeaker, 3" PM Dynamic, 3.2 ohm, V. C.
			RESISTORS:
			Fixed, Composition - Unless Otherwise Specified:
R101	269-474	82283-94	470,000 ohm, ½ w., ±10%
R102	244-0075	1220079-5	Variable, Dual, Style JJ, (5K/23K ohm) 2 w.
R103	269-101	82283-50	100 ohms, ½ w., ±10%
R104	269-104	82283-86	100,000 ohms, ½ w., ±10%
R105	269-153	82283-187	15,000 ohms, ½ w., ±5%
R106	269-243	82283-192	24,000 ohms, ½ w., ±10%
R107	269-152	82283-64	1500 ohms, ½ w., ±10%
R108			Same as R104
R109	269-153	82283-76	15,000 ohms, ½ w., ±10%
R110	269-472	82283-70	4700 ohms, ½ w., ±10%
R111	269-102	82283-62	1000 ohms, ½ w., ±10%
R112	269-243	82283-192	24,000 ohms, ½ w., ±5%
R113	269-822	82283-73	8200 ohms, ½ w., ±10%
R114			Same as R111
R115	269-393	82283-81	39,000 ohms, ½ w., ±10%
R116	269-271	82283-55	270 ohms, ½ w., ±10%
R117	269-681	82283-60	680 ohms, ½ w., ±10%
R118			Same as R111
R119			Same as R110
R120			Same as R111
R121	269-471	82283-58	470 ohms, ½ w., ±10%
R122 to R126			Same as R111
R127	269-105	82283-98	1 megohm ½ w., ±10%
R128	269-273	82283-91	270,000 ohms, ½ w., ±10%
R129	269-154	82283-88	150,000 ohms, ½ w., ±10%
R130	244-640	1220079-6	Variable, 1 megohm, 2 w.
R131			Same as R110
R132			Same as R109
R133			Same as R110
R134	269-224	82283-90	220,000 ohms, ½ w., ±10%
R135			Same as R110
R136, R137			Same as R104
R138	269-221	82283-54	220 ohms, ½ w., ±10%
R139	269-183	82283-77	18,000 ohms, ½ w., ±10%
R140			Same as R110
R141	278-0063	993005-31	3.1 ohms, W.W., 5 w., ±10%
R142, R143	278-0064	993005-51	31 ohms, W.W., 5 w., ±10%
R144	278-0065	993005-58	71 ohms, W.W., 5 w., ±5%
R145	279-0009	993006-67	200 ohms, W.W., 10 w., ±5%
R146	275-220	99126-42	22 ohms, 2 w., ±10%
R147			Same as R104
R148	269-103	82283-74	10,000 ohms, ½ w., ±10%

REPLACEMENT PARTS

Symbol No.	Stock No.	Drawing No.	Description
R149			Same as R111
R150	269-473	82283-82	47,000 ohms, ½ w., ±10%
R151	269-222	82283-66	2200 ohms, ½ w., ±10%
R152			Same as R111
R153			Same as R115
R154	269-332	82283-68	3300 ohms, ½ w., ±10%
R155	269-683	82283-84	68,000 ohms, ½ w., ±10%
R156	269-333	82283-80	33,000 ohms, ½ w., ±10%
R157	269-122	82283-63	1200 ohms, ½ w., ±10%
R158			Same as R148
R159			Same as R134
R160			Same as R103
R161 to R163			Same as R104
R164			47,000 ohms, Part of Z105
R165			47,000 ohms, Part of Z106
R166			Same as R148
R167	269-184	82283-80	180,000 ohms, ½ w., ±10%
R168			Same as R113
S101	328-0104	1241930-501	Switch - Rotary, 4 wafer
S102	328-0105	1241903-501	Switch - Rotary, 3 wafer & On-Off switch
S103	328-0109	3430685-1	Switch - Pushbutton
S104			Not Used
S105	328-0026	1220079-7	Switch - Toggle, S. P. S. T., 3 amp., 250 v.
T101	350-0354	1219540-1	Transformer - Input, EXO-5135
T102	350-0355	1219540-2	Transformer - Input, EXO-5315
T103	350-0356	1219540-3	Transformer - Input, EXO-5137A
T104	350-0357	1219540-4	Transformer - First Osc., EXO-5139
T105	350-0361	1214249-1	Transformer - Output, 3.2 ohm secondary
T106			Transformer - Part of Z102
T107			Transformer - Part of Z103
T108			Transformer - Part of Z104
TB101	777-0199	8893711-3	Terminal Board - Cinch-1783, 3 term.
TB102	777-0056	441608-11	Terminal Board - Jones-12-141-4, 12 term.
V101		12BA6	Tube - Vacuum
V102		12BE6	Tube - Vacuum
V103		19 X 8	Tube - Vacuum
V104 to V106		12BA6	Tube - Vacuum
V107		12AL5	Tube - Vacuum
V108		12AX7	Tube - Vacuum
V109		50C5	Tube - Vacuum
V110, V111		6BJ6	Tube - Vacuum
XDS101 to XDS104	777-3016	486673-16	Socket - Lamp
XFL101	261-0015	1214890-1	Socket - Filter, 9 pin miniature
XV101, XV102	261-380	737867-18	Socket - Tube
XV103	261-535	737870-18	Socket - Tube
XV104 to XV107			Same as XV101
XV108			Same as XV103
XV109 to XV111			Same as XV101
XY101 to XY121	261-813	8885952-1	Socket, Crystal
Y101 to Y120			Crystal (3402434) For Freq., See I. B.
Y121		1219539-38	Crystal (1245 kc/s)
Z101			Not Used
Z102 to Z104	350-0358	1219540-6	Transformer - IF, K-Tran. 1655-2
Z105, Z106	247-050	1214247-1	Filter - Printed Circuit, PC-50

REPLACEMENT PARTS

Symbol No.	Stock No.	Drawing No.	Description
C211	077-0001	442901-61	Electrolytic, 50 μf, 150 v.
CR101	263-240	1220079-3	Rectifier - Selenium, 150 ma, 156 v. Input rms
DS101 - DS106	202-253	990158-12	Lamp, Dial, Min. Bayonet, 6-8 v., 150 ma, Type 47
F101, F102	777-2058	990157-8	Fuse, 1 amp., 250 v.
F103, F104	777-1970	990157-11	Fuse, 3 amp., 250 v.
FL101	136-0012	1214248-1	Filter, Mechanical
J101	259-0032	845648-3	Jack, short frame
L101	350-0349	1239459-501	Coil - Radio Freq., Input, Band A
L102	350-0351	1239459-502	Coil - Radio Freq., Input, Band B
L103	350-0352	1239450-503	Coil - Radio Freq., Input, Band C
L104, L105	350-0074	1215560-4	Coil - Choke, Hash Filter, 22 μh
L106, L107	350-585	B-180-1	Coil - Choke, 5H, 140 ohms, 80 ma
L108	350-0353	1219540-5	Coil - B. F. O. - K-Train, exo-5316
L109	348-135	1220079-4	Coil - Choke, 500 μh, 75 ma
L110	350-0364	X-318-2	Coil - Peaking, 51.8 μh
L111	350-0358	1220079-8	Coil - Trap, 48.8 μh
L112	350-0363	3401774-1	Coil - Radio Frequency Tuning Band C
LS101	308-213	1215404-1	Loudspeaker, 3" PM Dynamic, 3.2 ohm, V. C.
			RESISTORS:
			Fixed, Composition - Unless Otherwise Specified:
R101	269-474	82283-94	470,000 ohm, ½ w., ±10%
R102	244-0075	1220079-5	Variable, Dual, Style JJ, (5K/23K ohm) 2 w.
R103	269-101	82283-50	100 ohms, ½ w., ±10%
R104	269-104	82283-86	100,000 ohms, ½ w., ±10%
R105	269-153	82283-187	15,000 ohms, ½ w., ±5%
R106	269-243	82283-192	24,000 ohms, ½ w., ±10%
R107	269-152	82283-64	1500 ohms, ½ w., ±10%
R108			Same as R104
R109	269-153	82283-76	15,000 ohms, ½ w., ±10%
R110	269-472	82283-70	4700 ohms, ½ w., ±10%
R111	269-102	82283-62	1000 ohms, ½ w., ±10%
R112	269-243	82283-192	24,000 ohms, ½ w., ±5%
R113	269-822	82283-73	8200 ohms, ½ w., ±10%
R114			Same as R111
R115	269-393	82283-81	39,000 ohms, ½ w., ±10%
R116	269-271	82283-55	270 ohms, ½ w., ±10%
R117	269-681	82283-60	680 ohms, ½ w., ±10%
R118			Same as R111
R119			Same as R110
R120			Same as R111
R121	269-471	82283-58	470 ohms, ½ w., ±10%
R122 to R126			Same as R111
R127	269-105	82283-98	1 megohm ½ w., ±10%
R128	269-273	82283-91	270,000 ohms, ½ w., ±10%
R129	269-154	82283-88	150,000 ohms, ½ w., ±10%
R130	244-640	1220079-6	Variable, 1 megohm, 2 w.
R131			Same as R110
R132			Same as R109
R133			Same as R110
R134	269-224	82283-90	220,000 ohms, ½ w., ±10%
R135			Same as R110
R136, R137			Same as R104
R138	269-221	82283-54	220 ohms, ½ w., ±10%
R139	269-183	82283-77	18,000 ohms, ½ w., ±10%
R140			Same as R110
R141	278-0063	993005-31	3.1 ohms, W. W., 5 w., ±10%
R142, R143	278-0064	993005-51	31 ohms, W. W., 5 w., ±10%
R144	278-0065	993005-58	71 ohms, W. W., 5 w., ±5%
R145	279-0009	993006-67	200 ohms, W. W., 10 w., ±5%
R146	275-220	99126-42	22 ohms, 2 w., ±10%
R147			Same as R104
R148	269-103	82283-74	10,000 ohms, ½ w., ±10%

REPLACEMENT PARTS

Symbol No.	Stock No.	Drawing No.	Description
R149			Same as R111
R150	269-473	82283-82	47,000 ohms, ½ w., ±10%
R151	269-222	82283-66	2200 ohms, ½ w., ±10%
R152			Same as R111
R153			Same as R115
R154	269-332	82283-68	3300 ohms, ½ w., ±10%
R155	269-683	82283-84	68,000 ohms, ½ w., ±10%
R156	269-333	82283-80	33,000 ohms, ½ w., ±10%
R157	269-122	82283-63	1200 ohms, ½ w., ±10%
R158			Same as R148
R159			Same as R134
R160			Same as R103
R161 to R163			Same as R104
R164			47,000 ohms, Part of Z105
R165			47,000 ohms, Part of Z106
R166			Same as R148
R167	269-184	82283-80	180,000 ohms, ½ w., ±10%
R168			Same as R113
S101	328-0104	1241930-501	Switch - Rotary, 4 wafer
S102	328-0105	1241903-501	Switch - Rotary, 3 wafer & On-Off switch
S103	328-0109	3430685-1	Switch - Pushbutton
S104			Not Used
S105	328-0026	1220079-7	Switch - Toggle, S. P. S. T., 3 amp., 250 v.
T101	350-0354	1219540-1	Transformer - Input, EXO-5135
T102	350-0355	1219540-2	Transformer - Input, EXO-5315
T103	350-0356	1219540-3	Transformer - Input, EXO-5137A
T104	350-0357	1219540-4	Transformer - First Osc., EXO-5139
T105	350-0361	1214249-1	Transformer - Output, 3.2 ohm secondary
T106			Transformer - Part of Z102
T107			Transformer - Part of Z103
T108			Transformer - Part of Z104
TB101	777-0199	8893711-3	Terminal Board - Cinch-1783, 3 term.
TB102	777-0056	441608-11	Terminal Board - Jones-12-141-4, 12 term.
V101		12BA6	Tube - Vacuum
V102		12BE6	Tube - Vacuum
V103		19 X 8	Tube - Vacuum
V104 to V106		12BA6	Tube - Vacuum
V107		12AL5	Tube - Vacuum
V108		12AX7	Tube - Vacuum
V109		50C5	Tube - Vacuum
V110, V111		6BJ6	Tube - Vacuum
XDS101 to XDS104	777-3016	486673-16	Socket - Lamp
XFL101	261-0015	1214890-1	Socket - Filter, 9 pin miniature
XV101, XV102	261-380	737867-18	Socket - Tube
XV103	261-535	737870-18	Socket - Tube
XV104 to XV107			Same as XV101
XV108			Same as XV103
XV109 to XV111			Same as XV101
XY101 to XY121	261-813	8885952-1	Socket, Crystal
Y101 to Y120			Crystal (3402434) For Freq., See I. B.
Y121		1219539-38	Crystal (1245 kc/s)
Z101			Not Used
Z102 to Z104	350-0358	1219540-6	Transformer - IF, K-Tran. 1655-2
Z105, Z106	247-050	1214247-1	Filter - Printed Circuit, PC-50

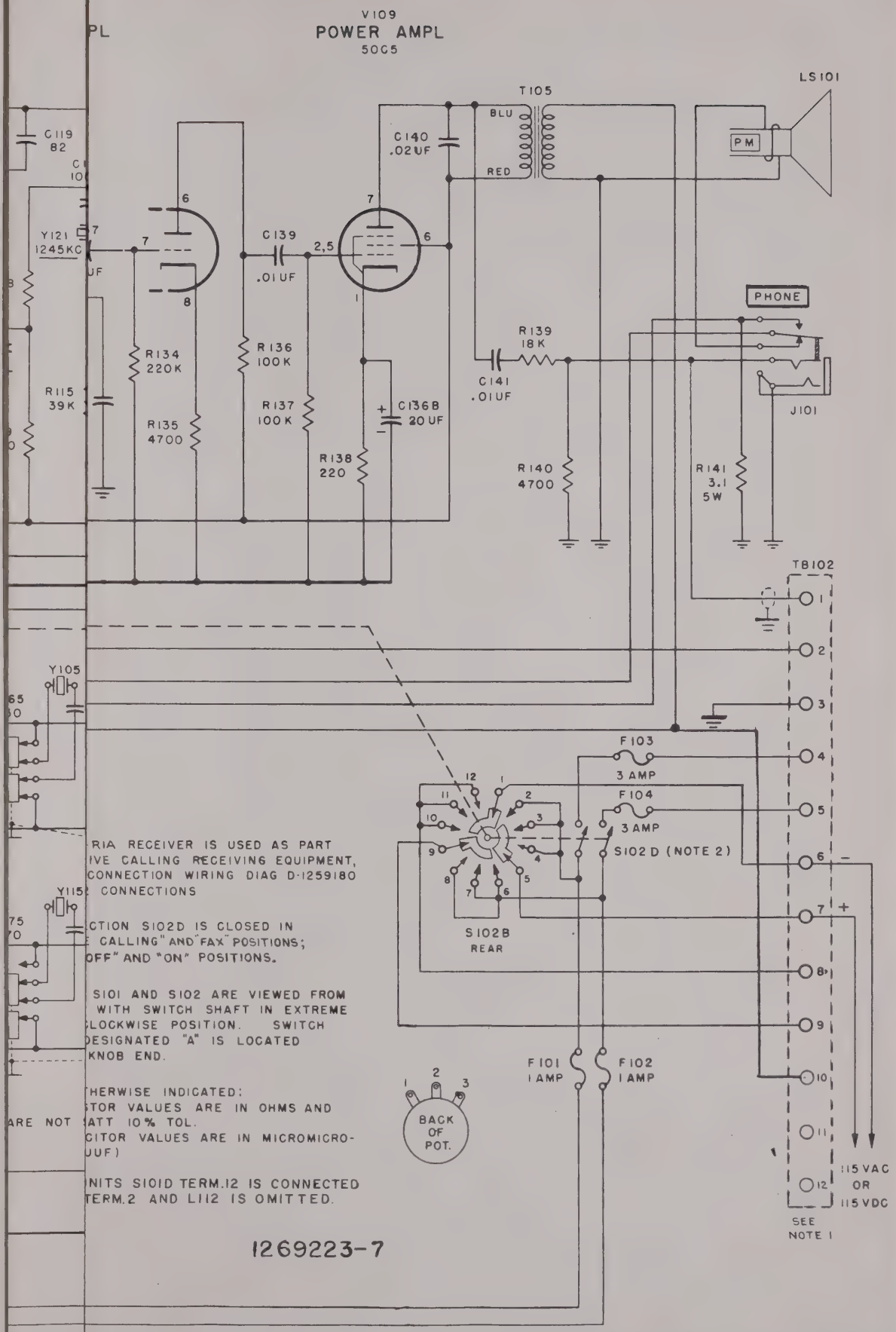


Figure 4. Schematic Diagram, CRM-R1A Receiver

REPLACEMENT PARTS

Symbol No.	Stock No.	Drawing No.	Description
R149			Same as R111
R150	269-473	82283-82	47,000 ohms, ½ w., ±10%
R151	269-222	82283-66	2200 ohms, ½ w., ±10%
R152			Same as R111
R153			Same as R115
R154	269-332	82283-68	3300 ohms, ½ w., ±10%
R155	269-683	82283-84	68,000 ohms, ½ w., ±10%
R156	269-333	82283-80	33,000 ohms, ½ w., ±10%
R157	269-122	82283-63	1200 ohms, ½ w., ±10%
R158			Same as R148
R159			Same as R134
R160			Same as R103
R161 to R163			Same as R104
R164			47,000 ohms, Part of Z105
R165			47,000 ohms, Part of Z106
R166			Same as R148
R167	269-184	82283-80	180,000 ohms, ½ w., ±10%
R168			Same as R113
S101	328-0104	1241930-501	Switch - Rotary, 4 wafer
S102	328-0105	1241903-501	Switch - Rotary, 3 wafer & On-Off switch
S103	328-0109	3430685-1	Switch - Pushbutton
S104			Not Used
S105	328-0026	1220079-7	Switch - Toggle, S. P. S. T., 3 amp., 250 v.
T101	350-0354	1219540-1	Transformer - Input, EXO-5135
T102	350-0355	1219540-2	Transformer - Input, EXO-5315
T103	350-0356	1219540-3	Transformer - Input, EXO-5137A
T104	350-0357	1219540-4	Transformer - First Osc., EXO-5139
T105	350-0361	1214249-1	Transformer - Output, 3.2 ohm secondary
T106			Transformer - Part of Z102
T107			Transformer - Part of Z103
T108			Transformer - Part of Z104
TB101	777-0199	8893711-3	Terminal Board - Cinch-1783, 3 term.
TB102	777-0056	441608-11	Terminal Board - Jones-12-141-4, 12 term.
V101		12BA6	Tube - Vacuum
V102		12BE6	Tube - Vacuum
V103		19 X 8	Tube - Vacuum
V104 to V106		12BA6	Tube - Vacuum
V107		12AL5	Tube - Vacuum
V108		12AX7	Tube - Vacuum
V109		50C5	Tube - Vacuum
V110, V111		6BJ6	Tube - Vacuum
XDS101 to XDS104	777-3016	486673-16	Socket - Lamp
XFL101	261-0015	1214890-1	Socket - Filter, 9 pin miniature
XV101, XV102	261-380	737867-18	Socket - Tube
XV103	261-535	737870-18	Socket - Tube
XV104 to XV107			Same as XV101
XV108			Same as XV103
XV109 to XV111			Same as XV101
XY101 to XY121	261-813	8885952-1	Socket, Crystal
Y101 to Y120			Crystal (3402434) For Freq., See I. B.
Y121		1219539-38	Crystal (1245 kc/s)
Z101			Not Used
Z102 to Z104	350-0358	1219540-6	Transformer - IF, K-Tran. 1655-2
Z105, Z106	247-050	1214247-1	Filter - Printed Circuit, PC-50

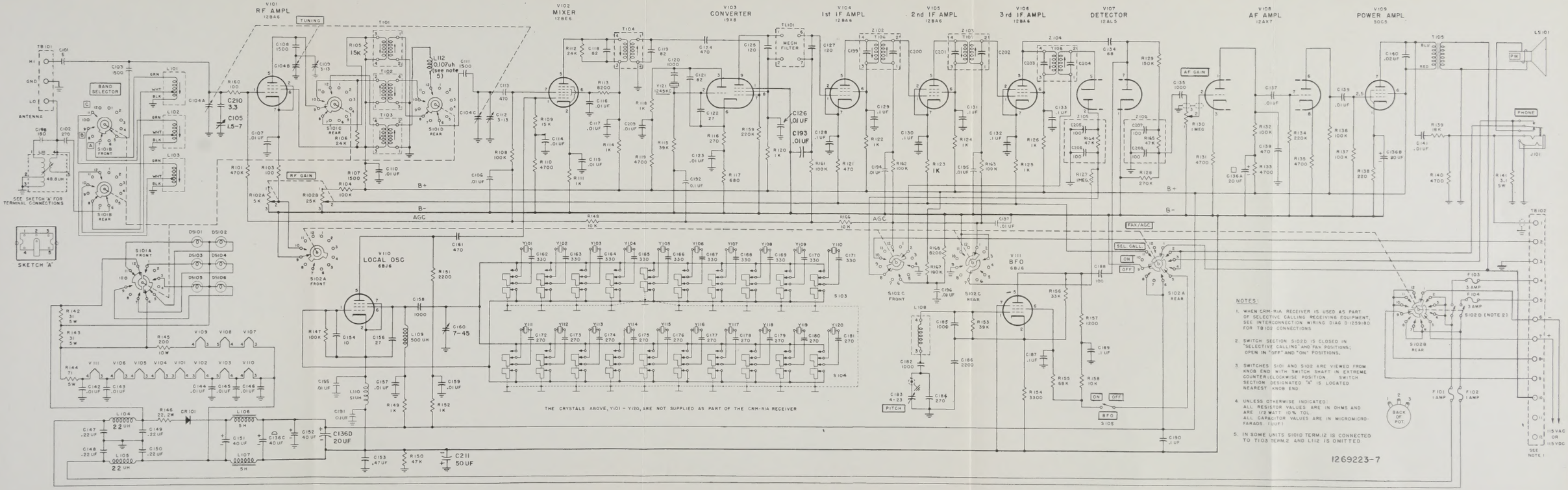


Figure 4. Schematic Diagram, CRM-R1A Receiver

APPENDIX B

RECEIVER MODIFICATION

This appendix contains a wiring schematic (figure B-1) which shows modification to the receiver for incorporation in the facsimile recording system.

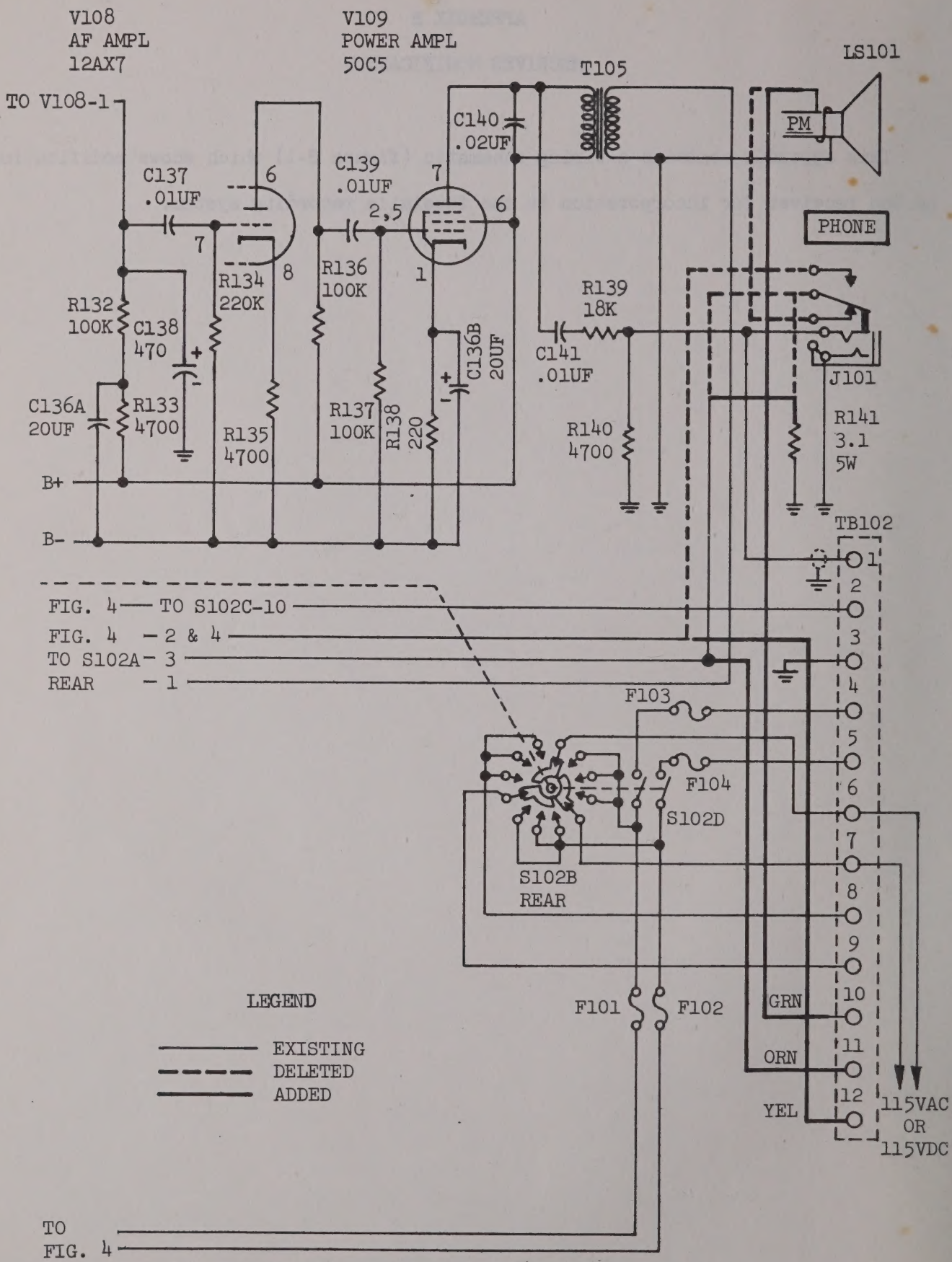


Figure B-1 Receiver Modification Schematic